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This camera is almost as small as a credit card. It's so small it can even fit in your shirt pocket. Yet it has an amazing 16 MB of built-in flash memory to store up to 109 photographs depending on resolution. Preserve nearly a lifetime of photographs by using the camera's SD card slot for removable memory cards.

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Six Mega Pixel Digital Camera

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- Uses interpolation to achieve 6.0 mega pixels
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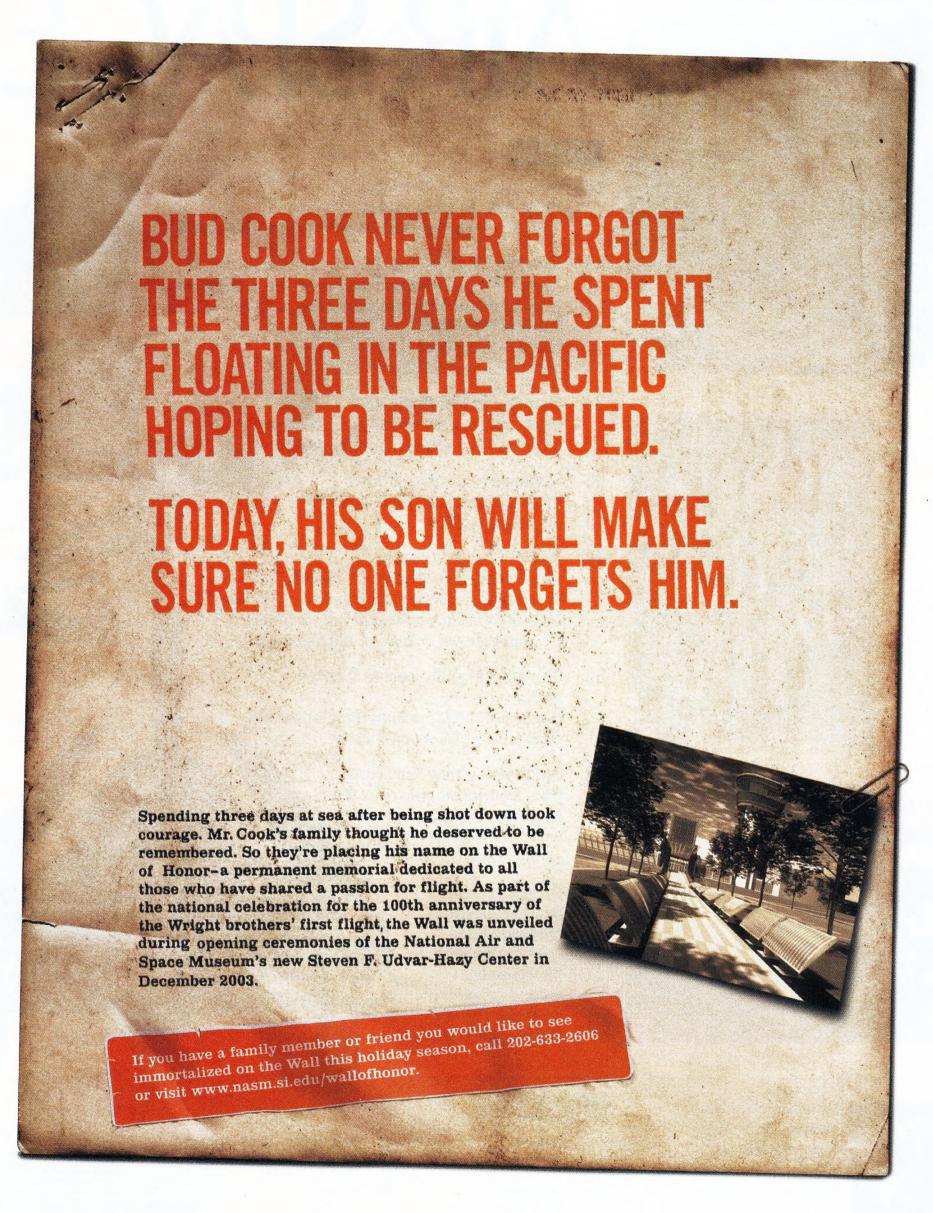
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Dancing in the Dark by John Croft Night vision goggles can save a pilot's life or, if he hasn't had adequate training, take it.

Scenes From a Dry Planet 40 Highlights from Spirit and Opportunity's adventures on Mars.

48 **FOURTH IN A SERIES:**

> The People and Planes of Flabob by Marshall Lumsden Photographs by Chad Slattery This California airport is hallowed ground for

homebuilders and Hollywood stunt pilots alike.

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the Flying Heritage Collection their sparkle?













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Cover: Devil with a pulse jet: Photographer John M. Dibbs made the Flying Heritage Collection's Fieseler Fi 103R look as menacing as it was when Hanna Reitsch flew a prototype.





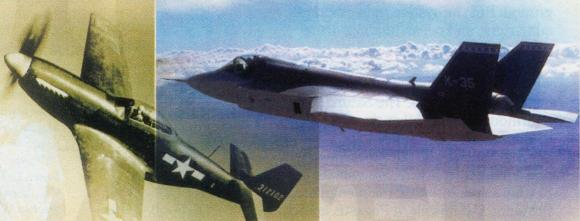
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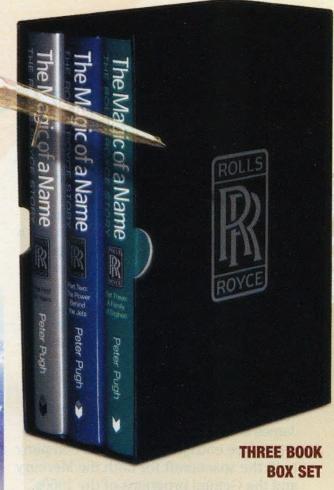
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Amazing Space

n October, the National Air and Space Museum celebrates another milestone at the Steven F. Udvar-Hazy Center at Dulles International Airport: the launch of the James S. McDonnell Space Hangar. The hangar has become a must-see attraction in the Washington, D.C. area because of its centerpiece, the space shuttle Enterprise, which was in place when the Udvar-Hazy Center opened in December 2003. With the hangar's outfitting, we will offer well over 100 large space artifacts that highlight human spaceflight, rocketry, space sciences, and satellite applications. The hangar is named for James S. McDonnell, a pioneer aerospace entrepreneur whose company built the spacecraft for both the Mercury and the Gemini programs of the 1960s.

Moving all these large artifacts posed unique challenges. We've become experts at moving aircraft, but the often irregular shapes and sizes of space artifacts forced staff members to be even more creative. They accomplished the job while managing the mammoth task of cleaning and restoring the *Enterprise* (see In the Museum, p. 14).

The entry to the McDonnell Space Hangar will be flanked by a 1950s Redstone booster, cut away to reveal its internal systems, and a 1940s Corporal with its launch apparatus.

In the human spaceflight area, there's a flight-ready Mercury capsule and the spacecraft that flew in December 1965 as Gemini 7. Close by, an Apollo "boilerplate" capsule, used for test and training, will be displayed with a flotation collar and its three bright orange righting spheres, which would inflate to turn the capsule over if it

accidentally landed upside down in the ocean.

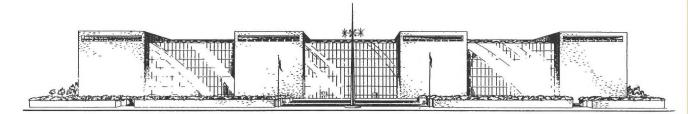
The Gemini program's Paresev Paraglider Research Vehicle is especially interesting. Designed as an alternative to parachuting space capsules into the ocean, this vehicle features a large parasail, much like that of a huge hang glider, to deliver capsules back to solid ground. But the system never worked quite right, and ocean landings were deemed more prudent.

In the rocketry section, visitors will see some of our collection of rocket engines and missiles. The Saturn V's enormous F-1 and J-2 engines, a developmental M-1 engine, and a variety of other missile and rocket engines will line a hangar walkway. We will also display a space shuttle main engine, a Poseidon C-3 missile, a Pegasus launch vehicle, and other rare missile technology from both the United States and Germany.

The satellite applications and space sciences sections will display ATS-1 and ATS-6 communications satellites, an Agena-B upper stage, and some launch computers. Nearby will be a suite of 20 scientific satellites and probes, a model of the Mariner 10 Venus and Mercury probe, engineering models of the Mars Pathfinder lander and Sojourner rover, and parts of the Apollo Telescope Mount (used on the Skylab missions).

This is just the initial portion of the artifacts that will be viewable in the coming months. I thank the staff for their efforts and the McDonnell family for its generosity.

—J.R. Dailey is the director of the National Air and Space Museum.



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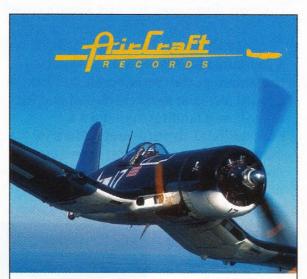
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LETTERS

Beached But Not Forgotten

I was surprised to learn that until recently, Burt Rutan had never flown in a production version of his Starship ("Beached Starship," Aug./Sept. 2004). At the June 21 launch of Rutan's SpaceShipOne, I photographed N514RS flying as a chase plane (below). I assume that this Starship belongs to Rutan's Scaled Composites, but it's hard to believe someone could own such a cool toy and never play with it.

Andy Ihnatko Boston, Massachusetts

Editors' reply: N514RS is actually registered to Robert Scherer of Newport Beach, California. It is the same aircraft that posed for last issue's cover.

"Beached Starship" omitted discussion of a fundamental reason for the demise of the Starship: the canard configuration. A canard airplane needs higher speed for takeoff and landing than does a conventional airplane and suffers in climbing rate; even its top speed is compromised because it gets appreciable lift from the small low-aspect-ratio

canard. Lots of articles have described the relative merits of ordinary airplanes versus canards. For example, Albert Blackburn's "Canards: The Myths and the Realities" (Technical

Soaring, July 1988) concludes: "There is no evidence that a canard configuration can equal the performance, handling qualities and structural efficiencies of the conventional aircraft."

Our 1977 Gossamer Condor and 1979 Gossamer Albatross human-powered airplanes were canards because that design minimized the configuration weight. However, we kept the lift coefficient of the canards low by locating the aircraft's center of gravity rearward. For our large, slow, unstable airplanes, the pitch disturbance was so sluggish and so easy to control that the pilots had no problem keeping the airplane at the desired pitch and airspeeds.

> Paul B. MacCready Chairman of the Board AeroVironment Inc. Monrovia, California

Of the turboprop corporate airplanes I have flown, one stands out as exceptional—the magnificent Starship. In design and construction the Starship was state of the art, and that does cost money initially. Though there were design problems, all were fixable. In my opinion, the real cause of the Starship's demise was the "not invented here" syndrome.

I became aware of a subtle but mutinous rejection by the old guard at Beech of the new corporate owners at Raytheon. Even the Beech president who followed Linden Blue badmouthed the airplane severely to the editor in chief of a major aviation publication.

The latter-day management's surreptitious destruction of the 80 percent prototype was an act of meanness toward the "outsiders" who conceived it: Beech's then-chairman Brainerd Holmes and designer Burt Rutan.

The long-running conspiracy to sink the Starship program has been unprecedented and disgraceful. The stockholders and Starship owners should be outraged.

John Lowery Folsom, California



An Extra 300, a Starship, and a Dassault-Dornier AlphaJet (left to right) formed up over Mojave, California.

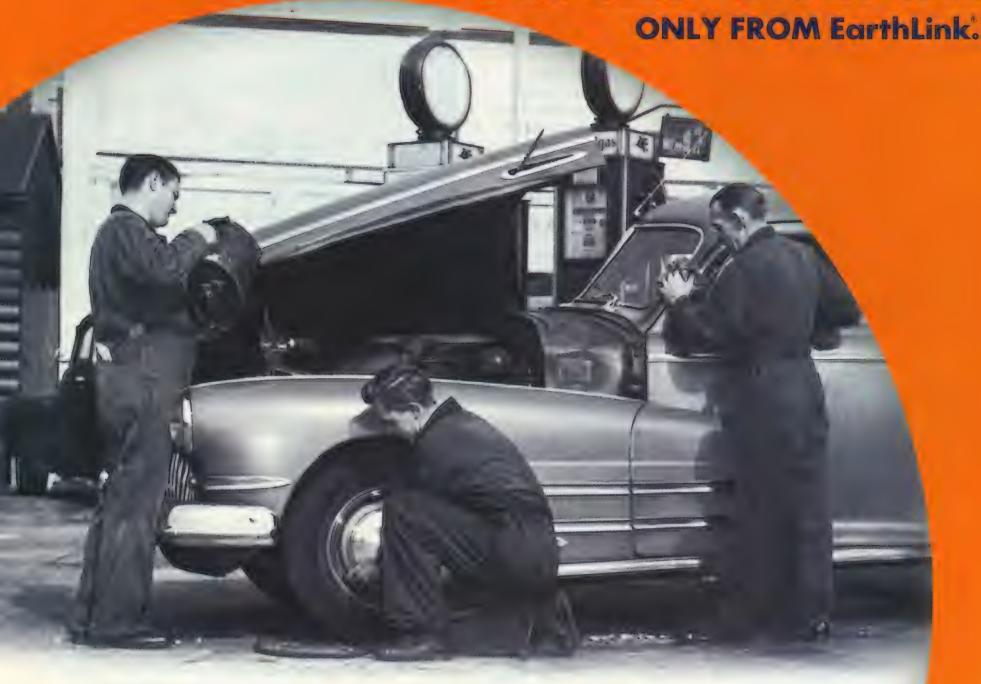
More Work for the Herk

The article "50 Years of Hercules" (Aug./Sept. 2004) forgot to include the C-130's aeromedical evacuation (AE) missions. As assistant chief flight nurse, I spent five months flying combat AE missions during Operation Iraqi Freedom in the Middle East, and I learned what an incredible aircraft the C-130 is.

I even got to fly on the Brits' J models. It was a real treat to see what the future holds for the U.S. C-130 program.

Maj. James Holl U.S. Air Force Reserve McGuire Air Force Base, New Jersey

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LETTERS

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> Mark Marchand Clifton Park, New York



A C-130 Hercules in yet another role: firefighter.

In the late 1990s I had the privilege of riding in the cavernous gut of a C-130 as a paying passenger on a regularly scheduled run from Quito to Loja on Ecuador's TAME airline. The luggage was loaded into a large net mounted on the rear cargo door; all that luggage was suspended just over the heads of the last few rows of passengers. The entire "safety demonstration" consisted of the loadmaster saying (in Spanish), "When the cabin door closes you must put on your seat belt. You are not to move until we land and I open the door again." The Herk had 1970s-vintage passenger seats bolted to pallets, which shifted several inches with a jarring clank every time the airplane hit a bump in the turbulent Andean air. Since my eyes were closed tight most of the flight I can't report on much else, except that the temperature in the cabin shifted from icy cold to Hadean hot in a matter of minutes, and that the captain preferred to thread the needle between the many volcanic peaks we passed, rather than fly over them.

Ross Sackett Memphis, Tennessee

A military C-130 saved our house from last July's Acton, California Crown Fire. When the aircraft under contract to the fire departments are grounded, military aircraft are sometimes called in to fight fires. I took a picture (above) of the C-130 making the first of five retardant drops, which stopped the fire from advancing into our neighborhood.

Randy Morley via e-mail

Attack on Metropolis

I take issue with Ed Regis' portraying Metropolis, Illinois ("Tiny Turbines," Aug./Sept. 2004), as isolated. First, our closest major airport is not in St. Louis but in Nashville, barely 160 miles away. Also, commercial flights are available into Paducah, Kentucky, and Williamson County, Illinois—much closer regional airports, with car rentals available.

I'm also not sure I understand Regis' observation that Metropolis is "of no particular charm, consisting mainly of used-car lots, video stores, tire outlets, bargain huts, gas stations...." These all represent people working hard to make a living, and I challenge Regis to find a town or city of any size that doesn't have these types of businesses.

Henry Nennstiel Metropolis, Illinois

Less Oxygen, Please

As a retired senior research associate at Amoco (now BP) and the inventor of the vapor recovery systems used at gas stations, I see a serious problem with the Federal Aviation Administration's proposed system for inerting the gas in an aircraft's center wing tank ("How Things Work: Safer Fuel Tanks," June/July 2004). John Hickey, director of the FAA's aircraft certification service, is quoted in the piece as saying: "We thought you had to get the oxygen down to about nine percent.... But we looked at 12 percent, and the tests said that it

LETTERS

works." The difference between a safe nine percent and a flammable slightly higher concentration is not a black-and-white affair; as the oxygen concentration increases, the energy required for ignition decreases. The 12 percent standard will not necessarily be effective against high-energy and/or high-temperature objects (e.g., a thrown turbine blade) that could puncture the fuel tank.

In an era when a terrorist can acquire shoulder-launched anti-aircraft weapons, which can serve as intense ignition sources, the FAA should reconsider circumventing the nine percent oxygen nonflammable limit.

Irwin Ginsburgh via e-mail

Back in a Flash

Readers of "The Rise and Fall and Rise of Iridium" (Aug./Sept. 2004) should know that the Web site *heavens-above.com* predicts visible passes of Iridium satellites. The user can specify any latitude and longitude, and the site will list upcoming passes. The site also gives the pass' magnitudes, which are often many times brighter than Venus.

David Shomper Boulder, Colorado

Corrections

Aug./Sept. 2004 "Midway Settles In" (Soundings): The first flight of a jet from a carrier was made by a de Havilland Vampire from the HMS *Ocean* in 1945, not by a Ryan FR-1 Fireball from the *Midway* in 1946.

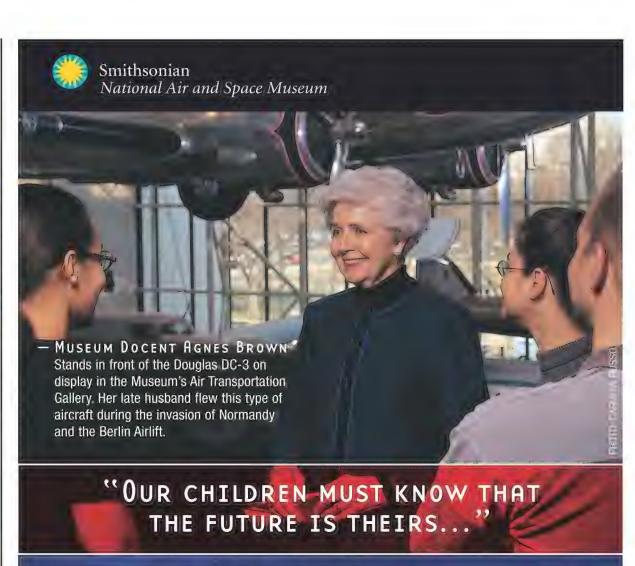
"Helluva Catch": CONTOUR was a flyby craft, not a sample-return craft, and was lost in August 2002, not 2003.

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e-mail: editors@airspacemag.si.edu. You must include your full name, mailing address, and daytime phone number.

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Agnes Brown has spent her lifetime helping children learn and explore. It's very reassuring for her to know that the charitable gift she makes today will ensure excellent educational opportunities for children tomorrow. Mrs. Brown is a museum docent as well as a retired principal. She has an excellent perspective on what the Museum can offer future generations. That's why she's established two charitable gift annuities and a bequest with the Museum.

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A&S 11-04

Arrowheads

rank Harvey's group, the Aerospace Heritage Foundation of Canada, searched the bottom of Lake Ontario for three days and couldn't find an Arrow anywhere. But disappointment is nothing new to this bunch.

The Avro Arrow was Canada's fighter-interceptor effort (see "Fallen Arrow," April/May 1998). Designed in the 1950s, the ultra-modern fighter (with fly-by-wire controls, 25 years before they became a standard feature on U.S. fighters) had an estimated top speed in excess of Mach 2. A.V. Roe Canada built six before hideous cost overruns and politics shot the project down. An oddly vindictive Canadian government decreed that all evidence of the Arrow be eradicated. "They ordered that all pictures, film, everything, was supposed to be destroyed," says Harvey. The prototypes were dismantled, and the photographs, designs, drawings, and test data confiscated from the engineers. Presumably it all ended up plowed under

The 500-lb. one-eighth scale models were used to test the aircraft's supersonic aerodynamics.





a field somewhere with lime sprinkled on the furrows.

Dedicated to preserving the memory of the Avro Arrow, the AHFC tracked down all that remains of the Arrow effort. In the Arrow's day, engineers had mated nine one-eighth-scale models to Nike rockets and launched them over Lake Ontario to test the aircraft's supersonic aerodynamics. Since the 500-pound models had sunk to the bottom, Harvey and crew figured they must still be down there.

Last July, the Canadian navy donated the services of two minesweepers and scanned the bottom of the lake with sonar and a remote-controlled, camera-equipped submersible. If they found anything promising, divers would have gone down for a closer look. "Part of the problem with the models is, we don't know the condition of them after traveling at Mach 2," Harvey says. "They could have deteriorated a bit and could have suffered

Scale models of the Avro Arrow were tacked onto Nike rockets and fired over Lake Ontario at speeds approaching Mach 2.

damage. And they might have drifted with currents."

They did find the Nike boosters on the lakebed, but they couldn't even bring those to the surface. Everything on the bottom of Lake Ontario is covered with zebra mussels, which are illegal to bring to the surface. "We have license to search but not to salvage," Harvey explains.

"We're going to sit back until spring and see about raising more money and go searching again," Harvey says. "It would be nice to get the Canadian navy to help again, and go a little bit further out this time." And if they do find a model, you can bet they'll apply for that salvage permit faster than a speeding arrow.

—Phil Scott

UPDATE

GoFast Goes the Distance

mateur rocketeers launched a 21-foot rocket to an altitude of 75 miles, well past the 62-mile "edge of space," last May in Nevada's Black Rock Desert ("It's All About Fire, Smoke, and Noise," Dec. 2003/Jan. 2004). "Rocketman" Ky Michaelson, last seen in these pages launching a faux Porta-John at a rocket meet in Kansas last year, led the Civilian Space Exploration Team effort. This was the third time the group attempted to cross the line between Earth's atmosphere and what is considered space. A ham radio package on the GoFast rocket broadcast its position and altitude during ascent, and the information enabled recovery of the spent rocket 25 miles downrange of the launch site. CSXT plans to offer the National Air and Space Museum the avionics from the first amateur rocket to reach space.

Radio Tidal Waves

uring the wee hours of last July 17 and 18, Scott Ransom was searching the sky with the new 100- by 110-meter radio telescope at the National Radio Astronomy Observatory in Green Bank, West Virginia. In one six-hour observation, Ransom, an NRAO staff astronomer, found 13 new binary and millisecond pulsars. It has taken 25 years to find just 100 of these exotic stars; Ransom's find of a baker's dozen in one day is unprecedented.

But Ransom almost missed his discoveries because "XM Rock," "XM Roll," and three Sirius satellites were blasting music and information to their terrestrial listeners. To radio astronomers, the new satellite-based radio services go by a different name: RFI, or radio frequency interference.

Radio astronomers are finding it increasingly difficult to study the weak radio signals coming from the edges of the universe. The explosion of satellite-based services, combined with rapid growth in cable TV, cell phones, wireless networking, and two-way radios has created a cacophony of radio noise in the skies that is drowning out the infinitesimal signals that help reveal the secrets of the universe.

Using a receiver capable of searching across 800 MHz of the radio spectrum and able to detect signals as weak as .00000000000000000000000000001 watt, Ransom had previously studied the same area of the sky. But the frequencies used by "Rock" and "Roll" and their three competitors, with relatively enormous power loads, were in the middle of Ransom's target frequencies. Transmitting as much as 13,000 watts of power, the satellites wrecked Ransom's observations by drowning the vastly weaker pulsar signals. "The data was garbage," Ransom says. He describes the first observations as "trying to find a candle on a far hillside with someone shining a spotlight in your eyes."

Even in a sky full of satellites, the new radio service satellites stand out. "These are the worst," says NRAO engineer Jeff Acree. "You can pick up these birds with a coat hanger." Acree's job is to make Green Bank as free of RFI as possible—which can entail hopping in a truck with a directional antenna to locate radio waves leaking out of a corroded cable TV connector on a utility pole.

To cut down on the overwhelming interference, Acree suggested that Ransom sacrifice a sizeable chunk of his searchable bandwidth and bypass the data-wrecking signals by redoing his observations, but scanning only the

PEOPLE AT WORK



The Best Jobs in Aerospace

James Darcy, Naval Air Systems Command Public Affairs Specialist

Naval Air Station Patuxent River, Maryland

very Navy and Marine Corps aircraft type that flies in combat has been developed and supported by Naval Air (NAVAIR) Systems Command. My job is to make sure that story gets told to the media and the taxpayers. On a typical day, I might interview a test pilot for a story I'm writing or sit along a runway with a camera to capture a historic test flight. Other days, I'm working with journalists or producers to show off our research, development, test, and evaluation capabilities.

NAVAIR in general, and Pax River in particular, is an amazing place to work. In one memorable hour by the runway, I saw 24 different aircraft models in the [traffic] pattern, including one X-plane, several pre-production models, and numerous unique test aircraft. But the best part is seeing how connected NAVAIR is to the aviators in the fleet, and getting a chance to tell that story. On September 12, 2001, I watched two Super Hornets scream over our building. I knew that this new aircraft, conceived, tested, and proven here, would succeed as a result of that work.

I started in military public affairs when I gave up freelance writing to take a civilian staff job at an Army newspaper. After a year with the Army, I jumped services and came to NAVAIR. Most civilians who work in Navy public affairs have backgrounds in public relations or journalism. Must-haves include professional communications skills and an understanding of what the media need from you to most effectively tell the story.

frequencies just below those used by the satellites. It worked. "This turned data which could have been terrible into data that is exceptional," says Ransom. "It made a huge difference in our observations."

Acree's solution may not work for very long. Despite the enormous strength of the signals, the satellites' bandwidths are somewhat confined. The big threat to radio astronomy is the proliferation of broadband wireless networking and the multiplicity of other broadband wireless devices. Even though the power of such devices is typically limited to one watt, "one watt is a lot of power around here," says a wary Acree. Inevitably, people near Green Bank will make wide use of low-power broadband devices, which will fill the local airwaves with a dull roar.

Unlike the strong interference from TV stations and satellites, which can be filtered out or sidestepped, equipment like the 802.11 "WiFi" computer network devices and the Family Radio Service walkie-talkies are spread so far across the radio spectrum that the interference they cause is "almost impossible to remove," Ransom says.

Despite his concerns, Ransom confesses to being part of the problem. "I'm a huge wireless computer user," he says. "I think it's fantastic. I just don't want it anywhere near my radio telescopes."

—Tim Wright

Eyes on the Prize

pace entrepreneurs don't normally flock to NASA bureaucrats like Brant Sponberg, seeing as how the next revolution in space travel is supposed to be led by the private sector, not the government.

Still, there was Sponberg at a Washington Hilton last June, before a wary but curious crowd of garage rocket builders and would-be builders, offering not to beat them but to join them. Or rather, reward them. Sponberg heads NASA's new Centennial Challenges program, which (if Congress approves) will award \$20 million in prize money next year for space firsts yet to be determined. The idea is to foster innovation in space technology using the kind of bait that lured Charles Lindbergh across the Atlantic in 1927 and aircraft designer Burt Rutan into suborbital space last summer. The purpose of the workshop—which drew more than 200 technical and business professionals from companies large, small, and not yet in existence—was to help decide what kinds of contests, prize money, and rules will work best.

Over the course of two days, the entrepreneurs suggested ideas for worthy challenges. First to land a lifeform on the lunar surface, then keep it alive for 90 days. First to place a radio transponder on an asteroid. Hell, first to move an asteroid.

Peter Diamandis, creator of the \$10 million Ansari X-Prize for which Rutan is vying, cautioned the group that the ideas had to be cool enough to capture public—and advertising—interest. "If it's boring it won't bring sponsors," he said. That didn't deter one university researcher from proposing a "perhaps not sexy, but important" race to see who could be the first to

giving game hurts or helps the cause of space privatization. A few thought it was such a pittance compared to NASA's \$16 billion annual budget as to be insulting. Rick Tumlinson of the Space Frontier Foundation scoffed, "If this trend continues, we foresee a day when NASA...might spend one-quarter or even one-half of a percent [of its budget] on real, proven hardware, instead of paper studies and pork." Sponberg countered that "20 million dollars is a lot of money to put on the table," considering, for example, that the Pentagon's Defense

BEST IN SHOW



Aerobatic superstar Patty Wagstaff congratulates winner Scott White.

1944 Boeing Stearman E75 Kaydet owned by Scott White of Orient, Ohio, was awarded the Rolls-Royce Aviation Heritage Trophy at the 2004 National Aviation Heritage Invitational Eastern Regional, held during the Dayton Air Show in Ohio last July. The E-75 was deemed the most historically accurate of the 10 aircraft entered in the invitational, which is open to airplanes at least 45 years old. The National Aviation Hall of Fame People's Choice Award, in which spectators cast their votes, went to a 1949 North American T-6G Texan owned by William and Jeanette Greene of Groveland, Illinois. Other trophy winners were a 1940 Howard DGA-15P, a 1928 Waco ATO, and a 1942 Stearman A75N1.

strengthen materials for spacecraft components by a factor of two.

Many of the attendees were from small, mostly unproven companies with names like SpaceDev, SpaceX, and Xcor who are on the verge of breaking into the commercial rocket business, or at least hope they are. The large, established companies were there mostly to observe. "The prize money isn't big enough" to catch the attention of Boeing or Lockheed Martin, admitted one aerospace executive.

In the hallways, attendees debated whether NASA's entry into the prize-

Advanced Research Projects Agency—DARPA—had offered just \$1 million as the prize for a robot race months earlier.

The skepticism didn't stop the ideas from flowing. First to demonstrate artificial gravity in a microsatellite. First "aquanaut" to walk on the bottom of the Marianas Trench. And sitting there in a session on lunar materials processing, taking everything in, was Erik Lindbergh, the vice president of the X-Prize Foundation and a commercial pilot, whose grandfather Charles knew a thing or two about winning contests.

—Tony Reichhardt

Will It Fly?

ast June, airport managers, scientists, and marketers gathered at Easton
Airport in Maryland, near the shore of the Chesapeake Bay, for a preview of NASA's Small Aircraft Transportation System—SATS. Over the course of 90 minutes, as the air conditioning sputtered, nearly half of the attendees took turns at the podium while the rest listened.

"I'd call it an intelligent pilot in a box," says Kyle Snider, whose company, Applied Systems Intelligence, says that its electronic copilot can monitor adverse weather and airspace boundaries. "A flight bag on steroids" says ARINC Inc. about its eFlightDeck, a portable electronic hand-held that replaces nearly every scrap of flight management paper carried by commercial pilots in bulky briefcases.

Over 98 percent of U.S. residents live within 20 miles of a public-use airport like Easton, while 75 percent of air traffic clogs the 29 largest airports. Planners think there should be a simple, safe way to get more pilots in smaller airplanes to local fields in most weather.

SATS envisions lower cost but more capable flight planning tools, digital connections between air and ground, a more precise Global Positioning System for landing in poor conditions. In most cases, the pilot, not the air traffic control system, would maintain his separation from other air traffic.

Before flying, pilots would insert a national access card at a SATS-Net kiosk, using a Web-based network for a weather briefing as well as a live camera view of the destination airport. While online, pilots could plan the en route frequencies and download navigation and airport charts. For navigation, pilots would use touch screens as well as verbal commands, while the enhanced pilot information system would capture data usually reported by radio, like the local altimeter setting.

Nearing the end of its five-year proofof-concept phase, SATS remains, for the most part, posters, PowerPoint presentations, and exhibits on card tables. Next year, at Virginia's Danville Regional Airport, real equipment will be taken aloft in a real airplane.

But more than one observer has discounted SATS as more animated than "The Jetsons." In its December 2002 report, Future Flight: A Review of the Small Aircraft Transportation System Concept, the National Academies' Transportation Research Board would not endorse SATS research and

development, explaining: "Although the cost of small jet engines could drop dramatically, small jets would still be well beyond the means of all but the wealthiest.... Sufficient market penetration to relieve congestion at hub airports would be unlikely. Without attempting to prejudge how advances in general aviation technology might evolve, the [TRB] concluded that the concept is problematic."

Besides, where would people fly? "The origins and destinations of most business travelers are major population centers, making travel to and from remote general aviation airports unappealing," the board concluded.

The National Institute for Aviation Research at Wichita State University is still surveying heartland residents about their interest in piloting, flying in advanced light aircraft, their proximity to smaller airports, and their preference for props or jets. "This is your chance to help shape the future of travel in the United States," the NIAR Web site says. "Our target audience is residents of Kansas, but we will gladly accept input from anyone."

-Roger A. Mola

WORK IN PROGRESS

laska's Pacific Seaflight marine transport service plans to launch a shuttle service between Juneau, Skagway, Haines, and Hoonah with a Flightship FS8 Dragon Commuter wing-in-ground-effect craft this fall. Designed in Australia, the WIG Flightship, powered by a Chevrolet engine, will operate about eight feet above the Pacific Ocean at 100 mph. While it looks, talks, and walks like an airplane, the Flightship falls under government regulations for small passsenger ships.

Electrifying Flight

This fall, thanks to the efforts of fuel cell expert James Dunn and his team of volunteer scientists, engineers, and students, the first airplane powered by electricity derived from hydrogen fuel cells will make its maiden flight at the

Worcester Regional Airport in Massachusetts. Though the e-plane's first flight will be powered solely by batteries (to test the electric drive system), highefficiency fuel cells have already been developed, and next spring Dunn's team hopes to see the airplane, a carbon fiber DynAero Lafayette kitplane, take off under battery power but cruise on hydrogen fuel cell power. In two years, the group plans to develop fuel cells so powerful that the aircraft can fly 500 miles on the cells alone.

The e-plane will demonstrate the viability of electric propulsion for aircraft. With only one moving part — the propeller—an electric airplane will be quieter and more reliable than

gasoline-powered, piston-driven versions. And a fuel-cell-powered plane will emit nothing, making it more environmentally friendly than conventional aircraft.

Dunn's team first had to come up with batteries that weren't too large or too heavy. Though lithium ion batteries would have been perfect, they're too expensive. Melding technology and practicality, the team developed a system for reconfiguring nickel metal hydride batteries from Prius automobiles recovered from junkyards.

A \$400,000 NASA grant funded the development of the fuel cells. In a midproject evaluation, says Dunn, NASA engineers were amazed by the efficiency and amount of power they generated. The U.S. Army will conduct high-altitude testing to make sure the cells perform at 18,000 feet.

Worcester Polytechnic Institute is developing the "reformer" technology that will allow the aircraft to fly without a heavy hydrogen tank. Reforming harvests hydrogen atoms from compounds such as ammonia, rather than using hydrogen gas. "The challenge is to make a reformer that's light enough, small enough, and reliable enough to be useful in aviation," says William Durgin, WPI's vice president of research.

News of the e-plane has spread through the aviation and engineering communities, and the original group of 20 volunteers has grown to more than 100. Among the volunteers are several air race pilots, including former space shuttle astronaut and pilot Robert "Hoot" Gibson, who will fly the airplane this fall (see Moments & Milestones, p. 80). "I think it's going to raise eyebrows and it's going to [make] headlines wherever it goes," Gibson says.

---Catie Foertsch

STANDING ON CEREMONY

Point Mugu Puts the Cat Out

Grumman NF-14D Tomcat nicknamed Bloodhound 200, a proud member of Air Test and Evaluation Squadron Three Zero Bloodhound at Naval Air Station Point Mugu in California, bids farewell to its longtime home as it heads for retirement at Davis-Monthan Air Force Base in Arizona. In a ceremony held on July 23 and attended by some 200 engineers, research and development workers, former Grumman employees, and F-14 program managers, the aircraft's designers and program leaders told their tales and turned BH200 over to a crew to make the last Tomcat flight at Point Mugu, which has for 33 years led the weapons research and the development, testing, and evaluation for the type. As the strike fighter's retirement looms, no further upgrades or modifications are scheduled for the aircraft that remain in service; from now on they will be based on the East Coast.



The last F-14 to fly at Point Mugu heads off to retirement at the Davis-Monthan base boneyard.

The First Shuttle

n 1976, the same year the Smithsonian Institution opened the National Air and Space Museum on the Mall in Washington, D.C., the space shuttle prototype *Enterprise* rolled out of the factory at Rockwell International in California. For the next three years, NASA used the vehicle in approach and landing tests, launch pad checks, vibration tolerance tests, and old-fashioned public relations stunts, including a flight around the Washington Beltway in 1983, while piggybacked to a Boeing 747.

"People here said it was just an amazing sight," says Valerie Neal, curator for the *Enterprise*, which is now on display in the James S. McDonnell space hangar at the Museum's Steven F. Udvar-Hazy Center at Washington-Dulles airport in northern Virginia.

By 1985, NASA was ready to retire the *Enterprise*, but the Museum had no room for it, so the shuttle camped out at Dulles airport. For several years it sat outside, visible to airline passengers taxiing by. Silt and water leaked into the

interior. The sun bleached the outer tiles. In 1992, a temporary structure was built to house the *Enterprise* and other artifacts. Still, by the time the shuttle was moved to Udvar-Hazy last November 20, it needed a rigorous cleaning.

The four people who did the work also refurbished the Boeing B-29 Enola Gay and other famous airplanes now located in the 290,000plus-square-foot aviation hangar that visitors first see when they enter the Center. Today, two of the crewmembers mill about the Udvar-Hazy Center's lunchroom, where a bottle of Goo Gone ("Removes tape, glue and more!") sits on the table next to some leftover Easter candy, and recall the task of cleaning up the Enterprise.

Neal explains why the restored *Enterprise* will not look like it did when it

Ed Mautner (foreground) inspects window seals while Tony Carp repairs holes made by woodpeckers, which had access to the Enterprise when it sat outdoors.

came off the assembly line. "We don't have the parts, including a boom that used to come off the nose," she says. As a test vehicle that never left Earth's atmosphere, the *Enterprise* was never equipped with the propulsion and thermal protection systems of a fullfledged space shuttle. Indeed, one mock panel in the back, where the aft reaction control system engines would normally be, is made of plywood and plaster. In many ways the *Enterprise* is part realdeal and part toy model, so the crew's job is less restorative and more cosmetic. After the cleaning, they will the paint the Enterprise. "It doesn't sound very romantic," says team leader Ed Mautner, "but we're just detailing the craft."

The work itself may sound mundane, but the passion that Mautner and the others bring to the job resonates like a good song throughout the space hangar. Mautner left his job as an auto mechanic in his mid-40s and returned to school to earn a master's degree in historic preservation. He landed an internship with the Smithsonian but spent four years waiting for a paid position at Garber, the Museum's storage and restoration facility in Suitland, Maryland. Once on the inside, he heard the Museum would give preference to employees who lived in Virginia for staff positions at the new Udvar-Hazy Center, so he convinced his wife to leave their home in Maryland and head for the Commonwealth. His gamble paid off; he was transferred to the facility last year.

"I feel so lucky to be here and to be able to work on noteworthy historical objects," he says, his face filled with the joy of a man doing precisely what he wants to do. "My dad brought my brother and I to the Smithsonian in 1957, when I was 13 years old and the aircraft were stored in some old tin shed in the back. I developed a life-long passion then."

As I come around the other side of the *Enterprise*, Neal points out that the leading edge on the wing is missing; NASA took it for testing after the *Columbia* accident. "This part of the





Carp directs the removal of part of the shuttle's maneuvering system.

aircraft is all made of fiberglass, whereas on the real shuttle they're made of reinforced carbon-carbon," she says "The *Enterprise* did not have to have an RCC panel because it was not going to get that hot. NASA took panels 5 through 9 and used them to set up the test rig to do the foam impact test. The *Enterprise* is the sister ship of *Columbia*: They came out of the same plant in '76. They are more alike than any other shuttles. So even though these were not RCC, they were the closest things [NASA] had.

"We'll be getting [the panels] back in the fall and [NASA] wanted to know if we wanted them to refurbish them or not. There are scuff marks across the bottom and they did ink the pieces of foam to track the path, but I think all of that is an interesting artifact as part of the life of this vehicle, so I'll have them leave it that way.

"Even in retirement the *Enterprise* is an asset to the national space program," says Neal. "NASA came back at least seven times in the last 15 years to inspect, borrow, or remove things."

The radical notion that a spacecraft could be reused led to radical new designs. Neal shines a light on the front cabin and then swings the beam along the body of the

Enterprise. "See, it starts out acting like a rocket [she flashes her light on the aft engines], then operates like a spacecraft in orbit [though the Enterprise never got fitted for that, she reminds me], and then on reentry it operates like a glider," says Neal. "There is no engine activity during the landing. It's literally falling out of the sky and it's just sheer aerodynamic control of the vehicle."

For the first time, I register that what I am looking at is the world's biggest glider. When I initially walked into the Udvar-Hazy Center, I saw the dark, sleek Lockheed SR-71, the world's fastest jet aircraft. The white *Enterprise* looms behind it, creating a startling visual contrast. Fast is cool, I think, but an orbiting 150,000-pound reusable aerobus, now that's downright extreme.

—Mary Collins



uring World War II, Germany's navy requested a small reconnaissance aircraft that could launch from German submarines, which hunted the waters for Allied vessels. Focke-Achgelis responded with the Fa 330, a rotor-equipped kite that could be towed through the air by a submarine, which had to maintain a minimum towing speed of 20 mph. The Fa 330 had no engine; instead, air passing over the three rotor blades caused them to rotate, generating enough lift to keep the craft aloft. If the U-boat came under attack and needed to descend quickly, the Fa 330's pilot was to pull a lever, releasing the aircraft from the towline. The pilot would then parachute into the ocean and wait to be picked up after the sub could safely resurface—that was the idea anyway. The U.S. Air Force donated an Fa 330A-1 to the Museum in the early 1960s.

VISITOR INFORMATION

Location The National Air and Space Museum is located on the National Mali, along Independence Arenne SW, between 4th and 7th Streets, Washington, D.C. The Steven E. Udvar-Haay Contexts at 15300 An and Space Museum Parkway, Channilly, Voginia, near Weshington Dulles International Airport.

Hours: The Museum on the Molf and the Udvar Hazy Center are open from 10 a.m. to 0:00 p.m. every day except December 25

Food. The Maseum on the Malifest the Wright Place Food Court, which offers selections from the breakfast and functioneries of McDanald's Boston Market, and Donates Pictoria. The Udvar-Hazy Content offers food service from Subway, located at the south end of the main beaugue. A feed court is scheduled to open next spring.

Shapping Body the Museum and the Udear Hazy Conter shape offer a various of souvening books, TVOs, models, posters, challing, and rays. A selection of these products can be purchased online in Small anguing Stormann.

Donald D. Engen Tower The Udvar Hazy Center has an observation tower from which visitors can watch air truthle arriving at and departing Washington Dulles International Airport. The only way in access the tower is via an elevation that cases 164 feet above the ground. The elevator can transport 15 people overy five minutes.

IMAX Theorems View Earth from the open cargo bay of a space should and experience the throbot professional automoting at the Meseon's Lockhoed Martin MAX. Theorem and the Udvar Hary Center IMAX Theorem where hero-formal time are projected onto a server five stories high. For information on tickets and showtones, call (677) (412-462).

NASM Express Shuttle Bus A round trip shuttle rigis between the Misseum and the Edvar Hazy Center from 9 a.m. to 5 p.m. Since the 37 should tickers sell on quickly, visitors are encouraged to norchase them in advance or (202) 640-662.

Jungle Graveyard

hen I returned to the Panama Canal Zone in the spring of 1945, after several years in the States, the war in Europe was just ending, and the Pacific war had only a few months to go. I was a 12-yearold boy with a summer before me: There was no discernible end to pleasure. At that time, in that place, pleasure was largely an endless reconstruction of The War, which, I and my comrades may secretly have hoped, might rage on long enough for our play to segue into actual combat—long enough for us to begin fighting in airplanes.

The Panamanian skies were full of reminders that the heart of modern warfare was aerial adventure. We might have preferred a few more fighters to flesh out the flights of P-39s, or an occasional pilgrimage of Spitfires and Typhoons. Now and then we saw the odd Thunderbolt or Mustang, or one of those fast, noisy bombers, a Mitchell or a

Marauder, landing at Albrook Field, or more distantly, at Howard Field, across the narrow moat of the canal. Mostly there were transports and utility planes, beginning with the letter C, which we found rather ordinary. And there were the stolid bombers: B-17s, B-24s, and, on the Atlantic side, PBYs, fanning out on submarine patrol.

The real excitement came when a carrier returned from the Pacific and threw its aircraft into a mock attack on the canal. We had Corsairs buzzing our neighborhoods, dropping flour bombs along the runways at Albrook. There were the Grumman cats, Dauntlesses, and Helldivers, all flown with the



AVNE SHII

abandon, it seemed to us on the ground, of wonderfully adroit adolescents. Afterward, there was talk of the possibly apocryphal close calls: a low-flying Hellcat's belly tank scraped off by the concrete lip of a culvert, a flour sack plunging through a parked airplane's wing. Later the carriers would dock and welcome civilians onto their decks, with the most thrilling machines on Earth in a blue tangle of folded wings.

We thought of The War as an air war, which is what it had largely become by then, but there seemed to be no way to bridge from that to play. Like so many young males before and since, our hearts lay in aviation, but we wound up in the

infantry. Most of the time we did what other kids did: conduct modest combat patrols. The difference was that we all had real machetes, and lived in a place where you didn't just kick through drifts of autumn leaves. Step off the road in Panama and you're in a jungle. It could have been Burma or New Guinea or the Philippines.

So The War, to us, was both terrestrial and tropical, the imagined enemy forever Japanese. We'd go off into the jungle with our machetes and toy guns, a file of pre-adolescent grunts threading among the towering hardwood trees and braided lianas and cut-grass. The hot, humid air weighed a ton, and all around

were bushmasters and fer-de-lances, wild boars, hairy spiders, large cats, howler monkeys—although we never saw one. Now and then an airplane would growl overhead, and we'd look up through the canopy with hope and envy, like all infantry.

One day, our whimsical patrol followed a narrow stream through the trees, farther than we normally went, far enough that we seemed to have departed the world of roads and wood-frame engines. The carcasses wore only the paint the airplanes had worn coming down the assembly lines at Douglas, Bell, and Curtiss. Inside, sockets gaped where instruments had once gleamed, and only the frames of seats remained, along with power pedestals and wheel-less control columns.

The exposed anatomy of these lost airplanes is still vivid, the aluminum radiant under the tropical sun, hot to the touch, angular and bare, a collection of containing oxygen masks, Mae Wests, rubber rafts, steel helmets and tropical liners made of pith, ammo belts, .45 automatics with the firing pins removed, shoulder holsters, fleece-lined leather caps, web belts, canteens, compasses, bayonets. We foraged timidly, considering the possibilities, understanding that while no one wanted this stuff, the present owners wanted no one else to have it.

We poached the site regularly, creeping in from the trees, spending time aboard the great hulks, then creeping out with some jewel of jettisoned matériel—but never very much. Then, like the grownup armies of the world, we went on to other things, leaving the rubbish heap of the Panama Air Depot to be subsumed into the Panamanian jungle.

If asked why we gave it up, I might have replied that we were boys, and boys were quick to tire of even new things. But mulling this today, it seems to me that the jungle graveyard simply wore us out. The reality of those metal bodies in the rainforest was immutable, and in the end, this must have spooked us. Warbirds can no more be reduced to toys than real war can be reduced to play. Inevitably, one sees in such fields of bones the once-grand herd of elephants.

—Carl Posey

We foraged the jettisoned matériel timidly, understanding that while no one wanted this stuff, the present owners wanted no one else to have it.

duplexes and manicured lawns. The jungle seemed infinite, the damp air velvet. And thus dissociated from civilization, we came suddenly to a place where the jungle ended in a tattered wall of trees. Beyond lay a tableau that moved us as an elephant graveyard moved the greedy Englishmen in *Tarzan* films.

Spread out over several acres bulldozed almost clear of trees lay the long, rounded hulls of A-20s, the blunt ones of B-24s, the remains of P-39s and P-40s. Fuselages lay in rows, some with wings removed at the root, some still winged but with nacelles emptied of

ribs, spars, skin, pulleys, rivets, severed cables, metal bones. The abandoned shells were discards, machines whose age, infirmity, and abundance had made them unworthy of peacetime repair.

Our footsteps echoing through the metal tunnels of the fuselages, we mimed war among the bombers and squatted in the boxes of Airacobra cockpits, finding these derelicts playable, though in a contemplative kind of way. Not even in our imagination were these airplanes going to fly us anywhere, but they were our ticket out of the infantry.

Nearby we discovered open bins



The Unwelcoming Committee

ur pilot began the approach to our refueling stop at North Dakota's Minot Air Force Base, where I spotted a line of six cars in Air Force blue at the base of the control tower. A reception committee of officers waited nearby. I wondered who rated such a display of military brass.

It was February 1966. The day had started with a high-pitched whine from the auxiliary power unit for our CH-47A Chinook tandem-rotor, twin-engine helicopter as it started up. On the intercom, the pilot asked the crew chief if everything was secure in back. "Ready to go," came the reply. The rear ramp closed with a clunk. The pilot lit off both jet engines. All five transmissions and the two rotor heads, each with three blades, engaged, adding to the cacophony of the engines. Once everything was rotating and vibrating in unison and the pilot was satisfied it would all stay together, he pulled up on the collective. The Chinook lifted off and headed north.

We had been at Ellsworth Air Force Base in Rapid City, South Dakota, to test the effects of rotor blade compressibility on the Chinook's performance. When the flight test engineer heard that it was 25 degrees cooler in Grand Forks, he opted to head north. The colder and denser air would result in a higher Mach number for the advancing rotor blade tip. The increased Mach number in turn would require greater engine power and fuel flow, decreasing the helicopter's range.

In the 1960s, the Air Force Flight Test Center at California's Edwards Air Force Base ran the flight test program for Army helicopters. Our test crew was from the rotary wing engineering section of the performance engineering branch. Though based at Edwards, we flew to various bases for flight testing, depending on the climatic conditions or altitudes needed for a particular program.

The test pilots, the maintenance crew, and I, the aide to the flight test engineer,

made up the military part of the crew. **Boeing** Vertol, the Chinook manufacturer, and Lycoming, the engine producer, each provided a technical representative. The instrument technicians and the flight test engineer were Air Force civilian employees. The mix of military personnel and civilians, flying an Army helicopter that was being tested by the Air Force, caused confusion whenever we were off our home base.

Because it was the height of the cold war, Strategic Air Command bases were tasked with maintaining a force ready to respond to a nuclear threat at a moment's notice. SAC often flew in to bases unannounced to make "operational readiness inspections" to gauge how well a wing commander was doing his job. A bad ORI report could cost him his command.

Our test helicopter, painted white with the nose and tail in Edwards Flight Test Center high-visibility orange, didn't quite fit the warrior mode of a SAC base—particularly with the nickname "Porky" painted on the front. ("It's a pig for maintenance," the crew chief had said. Relatively new in service, the CH-47A took a lot of ground crew hours for each hour of flight.)

On the way to Minot, lulled by the harmonics of rotary flight and the peculiar perfume of jet fuel, hydraulic fluid, and transmission oil, most of the crew in the back made niches in which to read, sleep, or watch the wide-open spaces of South and North Dakota roll by, punctuated by the occasional missile site.

Putting Porky into a hover, the pilot prepared to land on the ramp in front of

the control tower at Minot. All the brass ducked into cars and the tower to escape our frigid rotor wash. After shutting down, our pilot exited, and was greeted by the senior officer in charge of the reception. The two conferred for a few minutes, then the officer shook his head, turned, and gave an order. The blue suits jumped back in the staff cars and roared off.

A CH-47A

proved that

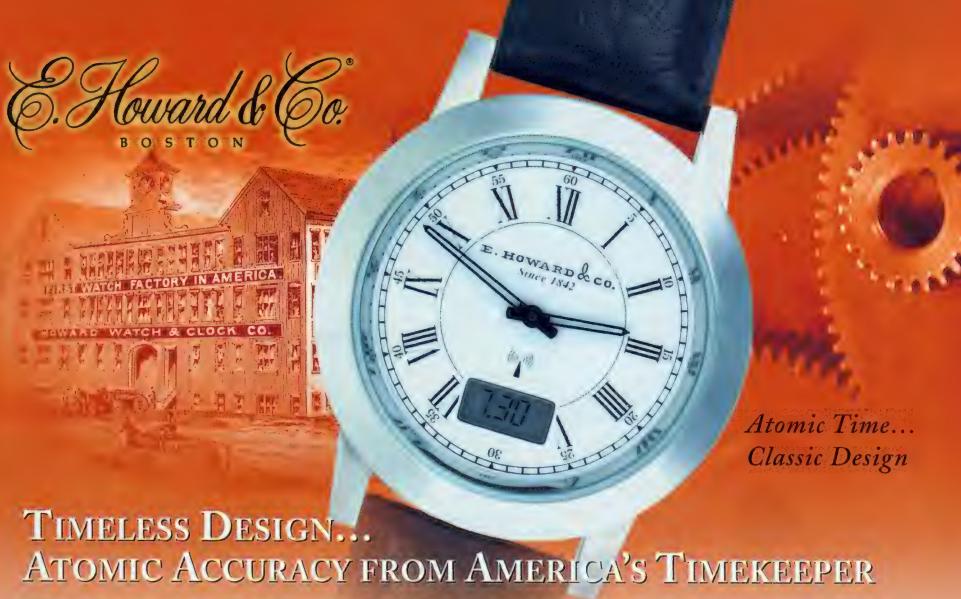
pigs do fly.

With a broad smile, our pilot walked back to his helicopter, where we waited, bewildered by the aborted reception. "They thought we were a C-47 with an ORI team on board," he said.

The SAC officer had explained that ORI teams always flew in on a C-47, the Air Force's version of the DC-3. The control tower crew at Minot had orders to alert the wing commander and his staff whenever a C-47 called in to land so they would have a little extra time to prepare to meet the inspection team.

When we had called in as "CH-47A on approach," the tower crew had picked up only "C-47." The call went out, the staff assembled—and instead of a reasonably streamlined military transport full of inspectors, the noisy, stubby, and colorful Porky vibrated in, bearing sleepy sightseers. I guess it was small consolation that they had escaped an inspection.

-Walter B. Rowe



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THREE COLLECTORS CONFESS WHY THEY HUNT DOWN AVIATION POSTERS. BY LINDA SHINER

e bought the first one for a dollar at a Connecticut flea market in 1961. Forty-three years and a hundred posters later, Bruce Whitman, a former B-25 pilot and president of the aviation and marine training company Flight Safety International, can say precisely what he likes about every single poster in his collection: the message.

"Patriotism. Commitment. Service," he says. "It's all about serving your country. And having been a pilot myself in the Air Force, [military aviation] was certainly one of the drawing forces." (Whitman earned a triple rating in the B-25: pilot, navigator, and bombardier.)

Most of his posters date from the 1940s, the decade before Whitman's own service in the Strategic Air Command and, he says, an extraordinary time for the country, a characterization repeatedly borne out in his posters by brief, urgent calls to action. "Everybody—everybody—in the country was needed," he says. "And everybody was together behind the war."

Whitman didn't set out to build a collection, but he enjoyed looking for the posters when he traveled, and he found them almost everywhere he went, from Paris to a small town in Nevada. "There's a lot of unproductive time when you travel," he says, "and I would ask to be directed to places that handled aviation memorabilia. I prowl around, visit kind of seedy antique stores."

He hasn't looked on eBay. "I don't think that's fun," Whitman says.

One of his suppliers is Meehan Military Posters in New York. Mel Meehan says the message is what brings in most of her customers. "I am a queen to scrap dealers because I can sell them a poster with a message like 'Scrap is the key to victory in World War II,' " Meehan says. "They buy the poster and put it on the wall in the office, and they feel ennobled."

Though most of her customers buy the posters "because they have an emo-

tional attachment" to them, there is the rare collector who sees his purchase strictly as an investment. "When a poster goes into a museum," she says, "it is there forever. And as more and more of these posters find their way into museums, the pool grows smaller." Vintage aviation posters are as finite as waterfront property.

Meehan's biggest sale was to a customer who had seen a rare poster on the public television program "Antiques Roadshow." Meehan had one, and the man was willing to pay what the show's evaluator estimated as its worth because, he said, "I know it's only going to be more expensive later." The price: \$28,000.

Most of the 3,000 posters in Meehan's inventory sell for considerably less. In general, she says, World War I posters are rarer and therefore more expensive than those issued during World War II. Recruiting posters and ads for U.S. Savings Bonds are less expensive because so many were produced.

The poster Whitman bought for a buck in 1961 would fetch considerably more today. A 1918 U.S. air service recruiting poster, it's listed in one of Meehan's catalogues for \$1,600. The most valuable in Whitman's collection are two posters signed by the artist Howard Chandler Christy. Both are rare, but about one of them, Mel Meehan says, "I've been in the business for 23 years. I've seen two." The poster was printed in 1920, when military need was not perceived to be great and the number of posters produced was correspondingly smaller.

Christy is best known as the artist who painted "The Signing of the Constitution of the United States," which hangs in the rotunda of the U.S. Capitol in Washington, D.C., but his chief work was illustrating; his drawings also appeared in magazines. "Aviation: Fly with the U.S. Marines" is different from his other illustrations. The art is dreamy; the message milder than the appeals of posters issued during wartime.



Howard Christy's 1920 call (above) joins a military aviation chorus.





"KEEP 'EM FLYING"
IS OUR BATTLE CRY!

DO YOUR PART

FOR

DUTY - HONOR - COUNTRY



at is not the message that entices Bill Allen to acquire a poster. "It's really the art," he says, "and not necessarily the quality of it but the impact it has and the pleasure you get from looking at it." Allen collects all kinds of aviation memorabilia for his Allen Airways Flying Museum, open by invitation only at Gillespie Field in San Diego. A developer, hotel owner, and private pilot, Allen has in his museum

six airplanes, 10,000 artifacts, and more than 400 aviation posters. In 2000 the National Air and Space Museum exhibited 32 of his early flight posters in a show that traveled the country. Allen published them with others in *Looping the Loop: Posters of Flight*, a large-format book of elegant advertisements for air meets and races, as well as military aviation posters of the two world wars. Another part of his collection

has never left Gillespie Field, though the posters themselves were seen by thousands when they decorated movie theaters in the United States and Europe.

A few years ago, Allen began to think of a second book, of aviation movie posters, when he acquired "a big slug of 'em and they were really cool," he says. They are captivating, not just for their graphics but for the history they

A 10-foot-wide banner (top) drew youngsters into the movies in 1935.

Five of the more than 200 aviation movie posters that Bill Allen hopes to assemble in a book span three decades and four nations. Left to right: a 1936 U.S. test pilot adventure, Howard Hawks' Only Angels Have Wings for French audiences, a silent film from 1926, a 1928 Soviet science fiction drama, and a 1941 Royal Air Force documentary about a bomber attack on Germany.







represent. You know just by looking at the "Tailspin Tommy" banner ("The greatest poster on the planet," says Allen) that 12-year-olds would have waited all week for Saturday mornings, when the 1935 series aired. Then you realize that many of those fans grew up to be the 20-year-olds flying warplanes in 1943. World War II is represented in the collection by documentaries as well as feature films. During

the war, the British Ministry of Information hired feature filmmakers to produce morale-boosting propaganda flicks starring the Royal Air Force. *Target for Tonight* (1941) shows the planning and execution of a Wellington bomber raid on Germany. The U.S. War Department followed suit, drawing on the talent of director William Wyler (*Roman Holiday*, *Ben-Hur*) for its documentaries. Aviation was also popular with di-

rectors who made romance and adventure films in the 1930s, some more capably than others. The 1936 movie *Devil's Squadron*, about the dangers test pilots faced, is not in the same league with *Only Angels Have Wings*, a 1939 drama with Cary Grant and Jean Arthur, set in South America and directed by Howard Hawks (a pilot in World War I). The disparity proves that you can't judge a film by its poster.









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or Peter Kramer, it's a matter of heredity. His dad flew in B-24s as a navigator in World War II, "came back, had 10 kids, and never flew again, but he photographed airplanes his whole life," Kramer says. His father documented most of the national air races in the 1930s, and he passed along the passion for air racing to his son. When his dad died at 75 (he had been at the airport with his camera that day, Kramer says), he also passed along to his son his photo collection and racing programs from the 1930 and 1939 national air races. At first, Kramer, who rebuilds Corvettes at a restoration shop near Chicago, wanted to find racing programs just to fill in the rest of the decade: the Golden Age of racing, when most of the events were held in Cleveland, Ohio. Thirteen years later, he has every racing program from 1920 to 1949 except the one from the Spokane Air Derby in 1927 (he's buyin' if you're sellin') and has branched out into posters.

Kramer bought the 1930 Chicago National Air Races poster from Bill Allen; it's from the first race his dad attended. He has also traded with fellow collector John Garrett, a Costa Mesa, California businessman who built his collection from "bits and pieces" he found in the 1960s. Kramer calls himself "just a regular guy, not a big collector like Bill Allen," but he does have one big-ticket item: the poster advertising the first international air meet in Rheims, France. (At that 1909 event, Glenn Curtiss and his Golden Flyer won the Gordon Bennett Trophy, plus a \$5,000 prize for the best speed in a two-lap, triangular 10-kilometer [6.2mile] course, averaging 47 mph.) Kramer looked for years for the poster, found it through a New York auction house, and bought it for \$5,400.

The sentimental value of Kramer's collection, the aesthetic delights of Bill Allen's, the love of duty and country in the posters of Bruce Whitman—posters satisfy a range of hankerings. Mel Meehan, who trained as an art historian and taught for 12 years at Indiana University, likes the posters because, she says, they are not "art with capital letters. They were thought to be disposable, to be put on walls and get rained on. And that makes them kind of wonderful. They are immediate. They were done fast, and there's no filter, so they are mirrors of the time."

And some come with a message.

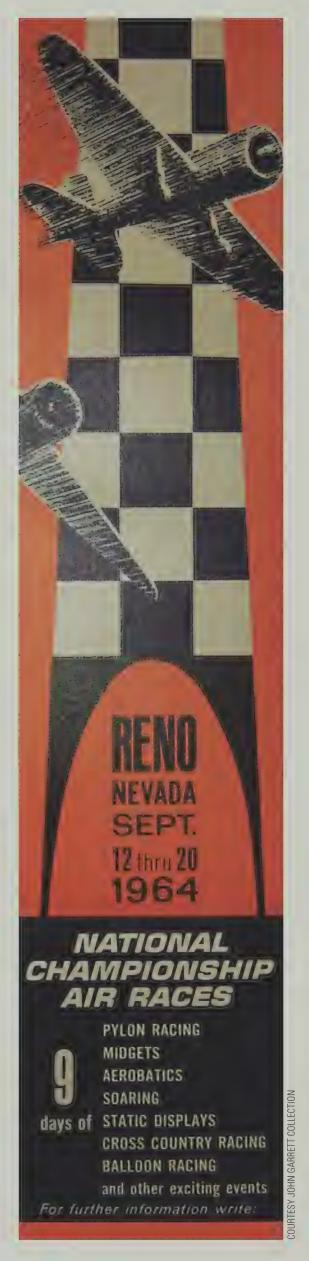


Opposite: The first air racing poster. Below: Peter Kramer's oldest U.S. poster announced a 1912 race.



John Garrett's lot includes early Reno posters (right) and spans 90 years. Below: Kramer's hometown favorite.





HOWARD HUGHES'

BY PRESTON LERNER

Wealthy beyond measure and weird beyond belief, Howard Hughes was a daredevil sportsman, legendary Lothario, Hollywood producer, Las Vegas mogul, and aerospace leviathan, a composite of myth and melodrama. No wonder he has inspired a cottage industry of biographies, memoirs, novels, and movies.

The latest Hughes biopic, directed by Martin Scorsese and starring Leonardo DiCaprio, is titled *The Aviator*, which may seem surprising to all but aviation enthusiasts. Although Hughes is remembered these days mostly for a pathological late-life fear of germs, he was once world-renowned as a record-setting pilot, a patron of pioneering aircraft, and a principal architect of the airline industry.

"Howard loved the drama of flying," says Robert W. Rummel, who worked with Hughes as a young engineer and later as a TWA executive. "He was an outstanding pilot, and in the cockpit, he seemed to exult in the freedom of flight. Of course, he was an astute businessman, and making money was one of the things that motivated him. But he had a sincere and abiding interest in aviation, and I think it was his one and only true love."

Hughes owned countless aircraft, which he stashed all over the country and flew whenever he felt like it—or not at all. The following are the ones that played the most significant roles in Hughes' aviation affairs.

The Blue Streak

Hughes went into the airplane business in 1934. At 28, he'd already produced and directed *Hell's Angels*, a film epic about World War I aerial combat, and he'd recently set a national speed record and won a race in a highly modified Boeing 100A biplane. Now he assembled a small team of employees into what would eventually become the Hughes Aircraft Company and embarked on the project that anchored his place in aviation history.

The company's first creation, the H-1, the 1B, or, his preference, simply the Racer, coupled noble proportions and graceful styling with leading-edge technology—many prop-heads call it the most beautiful airplane ever built. "The H-1 was an extraordinarily advanced example of what we would call a technology demonstrator," says aerospace historian Richard P. Hallion. "Monocoque stressed skin, flush rivets, hydraulic land-



THE TYCOON OWNED DOZENS OF AIRCRAFT BUT HELD ONLY A HANDFUL NEAR AND DEAR.



27



In July 1938, Hughes landed at New York's Floyd Bennett Field after flying around the world in a Lockheed 14 in just under four days.



A myth grew that Hughes had designed the Constellation. After some prodding, he acknowledged in a letter to the Lockheed board chairman that the C-69 was "designed, engineered, and built by Lockheed."

ing gear, and so on—for a guy who was just coming out of the box, if you will, it's a remarkable achievement."

Hughes harnessed the 1,000 horsepower of a Pratt & Whitney Twin Wasp Junior to set an international speed record of 352 mph in 1935 before making a gear-up landing in a bean field. In 1937, fitted with longer wings, the Racer took Hughes from coast to coast in seven hours, 28 minutes, breaking the transcontinental record he'd set the previous year in a Northrop Gamma. Hughes never flew the H-1 again. It was retired to a Quonset hut in Southern California after a mere 42 hours of flight time.

In 1975, Hughes had the Racer restored and trucked to the National Air and Space Museum, where it resides today. In 1998, a cadre of enthusiasts led by Jim Wright of Cottage Grove, Oregon, arrived in Washington, D.C., to take detailed measurements of the Racer. With that data, Wright and company reverse-engineered a replica that was the world's most ambitious homebuilt (see "Silver Bullet," Apr./May 2003). In 2002, Wright set a new speed record with it. Tragically, he was killed and his replica destroyed when he crashed in Yellowstone National Park last year.

Cabin Class

The Racer whetted Hughes' appetite for more records. To set an around-the-world mark, he bought the sole Douglas DC-1 but dumped it almost immediately for an amphibian, which he could set down on water in case of an engine problem. Hughes already had plenty of experience with a Sikorsky S-38. He bought a new Sikorsky S-43, a twin-engine amphibian that was 70 mph faster than the S-38.

The S-43 proved to be unsuitable for around-the-world duty, but Hughes continued to modify it until crash-landing in Lake Mead, near Las Vegas, in 1943. "The [center of gravity] was just way too far forward," says Bruce Burk, who started working for Hughes in 1937 and later oversaw his personal fleet. "If it had happened on the ground, you would have called it a ground loop, so I guess this was a water loop."

Two passengers died when a propeller sliced through the fuselage. Hughes, who suffered minor injuries, spent a small fortune to recover the S-43 and a larger one rebuilding it. The airplane eventually landed at the Hughes Tool Company in Houston, where it sat for many years before the Hughes estate sold it in 1977.

Hughes had not abandoned his around-theworld dreams, however; he next chose an airliner for the trip, a Lockheed 14 Super Electra, one of only four sold to private owners. (The rest went to airlines.) Although the Super Electra was too small to compete with the DC-3 in the airline business, its speed made it an around-the-world contender. Hughes commissioned Lockheed to equip a 14-N2 with two G-series Wright Cyclone engines. His crew added extra fuel tanks and copious navigation equipment. In 1938, after a trip that lasted nearly four days, Hughes and three crewmen returned to a New York City ticker tape parade. "All we did," Hughes disingenuously told reporters, "was to operate this equipment and plane according to the instruction book."

Mission completed, Hughes set his sights on the more advanced Boeing 307 Stratoliner, which mated the wings and tail of a B-17 bomber to the fuselage of the world's first pressurized airliner. He had the customary long-range mods, but by the time the airplane was ready for an around-the-world attempt, most of the world was embroiled in war.

In the late 1940s, Hughes hired industrial designer Raymond Loewy to spruce up the Stratoliner with a deluxe interior featuring a bar, kitchen, powder room, sleeping quarters, and other amenities. But Hughes still didn't



Inarguably Hughes' finest creation, the H-1 Racer incorporated hydraulic landing gear, flush rivets and joints, a bell-shaped streamlined cowling, wing fillets, and a retractable tail skid. Hughes called it "this beautiful little thing," but after setting both a world speed record in 1935 and a transcontinental record two years later, he never flew it again. Fortunately, in 1975 he gave it to the National Air and Space Museum. Some 20 years later, Oregonian Jim Wright (below, at cockpit) set about reverse-engineering a replica, with which he set a new speed record in 2002.





In 1939, Hughes bought a Boeing Stratoliner (below) for a second around-the-world flight, but World War II intervened. Hughes later converted the 307 to a luxury transport. Today, all that remains is the fuselage, which came back as a motor yacht (right) in Florida.





Hughes, wearing his "lucky fedora," runs up the XF-11 engines at the Culver City plant in 1946. The hat failed him; during the first flight, he barely survived a crash in a Beverly Hills neighborhood.

like the airplane, so he sold it to ostentatious Texas oilman Glenn McCarthy, the inspiration for Jett Rink in Edna Ferber's novel *Giant*. McCarthy never paid Hughes, and the Stratoliner—dubbed "Flying Penthouse" by a later owner—had accumulated only 500 hours by the time it was badly damaged by Hurricane Cleo in Fort Lauderdale in 1964.

Five years later, the airplane was saved from the scrap heap by Fort Lauderdale pilot and realtor Ken London, who bought it for \$69 and preserved most of the fuselage—including the cockpit—by transforming it into a houseboat. In 1981, Dave Drimmer bought it even though the Howard Hughes provenance sounded dubious. "I wanted the boat because it was funky and cheap, and if it was Howard Hughes' plane, well, how cool would that be?" he says. In 1994, while restoring the cockpit, he found the original Boeing data plate. Drimmer now rents out the boat for charters and tours (see www.planeboats.com for its history).

Hughes' ownership of a good chunk of TWA's stock gave him a vested interest in the development of airliners. In 1939, he sketched out the broad requirements for what eventually took form as the Lockheed 049 Constellation. The Constellation delivered high speed and great payload capacity in an elegant package featuring four neatly cowled engines, a triple tail, and a graceful dolphin-shaped fuselage. Beloved by pilots and pas-



Hosking, the good news was that the screenplay for *The Aviator* called for boffo flying sequences featuring the Hughes Racer, the XF-11, and the H-4 Flying Boat. The bad news was that there were no flyable examples of these airplanes. So Hosking, a veteran of aerial extravaganzas ranging from *Con Air* to *The Sum of All Fears*, had to dig deep into his bag of cinematic tricks.

"We used every process known to man on this movie," he says. "And when that wasn't enough, we invented new ones."

The Miramax movie, which follows Howard Hughes from the late 1920s to the late '40s, posed a host of challenges. For example, for the opening scene—the making of *Hell's*

The Cast of "The Aviator": Replicas and Mockups

Angels—Hosking and assistant aerial coordinator Matt Sparrow had to sweet-talk owners all over the country to amass a fleet of 15 World War I airplanes, mostly Fokker D.VII and Sopwith Camel replicas.

Later, a privately owned Sikorsky S-38 reproduction acted as Hughes' first amphibian, and a Lockheed Super Constellation flew in from the Airline History Museum in Kansas City, Missouri, to serve as the template for a computer-

generated sequence showing dozens of Constellations on an airport ramp.

Meanwhile, special effects supervisor Bruce Steinheimer oversaw the construction of full-scale mockups of the Racer, the XF-11, and the H-4. (There was also a mockup of the Flying Boat's flight deck.) The back half of a Vultee BT-13 Valiant was fashioned to look like the Racer so Leonardo DiCaprio could be filmed in the rear cockpit while Hosking flew from the forward cockpit.

For the XF-11, model makers built a bizarre contraption consisting of a full-scale canopy nestled between stunted wings that look lifesize when filmed through a forced-perspective camera. "I fought long and hard against it because I didn't think it would look realistic," Hosking says.

"But by golly, I had to eat my words"

In addition, Miramax built remote-controlled scale models of all three airplanes. For what he believes to be the first time ever, Hosking filmed them from a helicopter while he flew close formation with the models, which were controlled by RC pilots. "It was a little tricky," he admits. "But in effect, I was the wingman, so it was up to me to keep separation."

Hosking tried to minimize the computer-generated stuff and the use of blue-screen technology—the modern version of the old-timey movie technique in which the driver saws at the steering wheel while the background dances around behind him. So how did he crash the XF-11?

He laughs. "I left that up to the computer guys."



sengers, it was the most refined airliner of its day, and it was ideally positioned for the postwar boom in intercontinental travel.

Hughes liked the Constellation so much that he bought 40 of them for TWA. But by the time they were built, the United States had declared war. TWA assigned the rights to its fleet to the Army Air Forces, which designated the craft C-69s: military transports. In 1944, Hughes and TWA president Jack Frye delivered the first Constellation to the military in person, sharing a new coast-to-coast record of a tick less than seven hours.

Hughes liked to claim credit for designing the Constellation, which so annoyed Lockheed design honcho Kelly Johnson that he justifiably demanded a retraction. "Eventually," Rummel recalls, "Howard agreed to say that he had conceived of the airplane while Johnson designed it. But privately," Rummell adds with a chuckle, "Howard told me that he had difficulty understanding the difference between conception and design."

The Black Period

While Hughes was setting records in the 1930s, Hughes Aircraft was gearing up for the war effort. The design staff produced several concepts for the military competition won by the Lockheed P-38 Lightning. Hughes then emLeonardo DiCaprio, sans fedora, preps for a faux flight in the XF-11 mockup.





The Flying Boat fuselage lumbers through an intersection en route to a seaside facility (top). After several moves, it now lives in the Evergreen Aviation Museum in Oregon (above).

barked on his own project, unfettered by military requirements. Designed at various times to be a pursuit aircraft, attack aircraft, and bomber, it turned out to be none of the above.

Like the P-38, the D-2 featured an unusual twin-engine, twin-boom configuration. What made it unique was that it was built of alternating layers of heat-treated wood veneers and epoxy resin glues. This so-called Duramold process enabled exceedingly smooth surfaces. Better still, wood was cheap and widely available. But brief test flights in 1943 exposed the

airplane's flaws. "It turned out to be a dog," Burk says. "The ailerons were almost completely ineffective, so it had no lateral control." It was no great loss when the lone D-2 was destroyed in 1944 by a fire said to have been caused by a lightning strike.

By this time, the politically savvy Hughes had already secured a military contract for the XF-11, a larger, more powerful all-metal version of the D-2. Designed as a 400 mph, high-altitude reconnaissance aircraft, it was powered by a pair of turbo-supercharged Pratt & Whitney R-4360-31s driving two pairs of counter-rotating propellers. "It was a very highly developed, well-thought-out design," Hallion says. "If Hughes hadn't been so wrapped up in the HK-1 [flying boat], that airplane might have entered the inventory."

As it was, the XF-11 wasn't completed until the war ended. On the craft's 1946 maiden test flight, an oil leak caused the right rear propeller to reverse pitch, the engine lost power, and the airplane crashed in Beverly Hills, damaging some houses. Hughes, the only one injured, was pulled from the wreckage in critical condition. While he recuperated, a second XF-11 was assembled with conventional four-blade props. Nine months after the accident, Hughes successfully flew the airplane. It then passed into the hands of the Army Air Forces before being scrapped in 1949.



It took four years for the Flying Boat to come together. Win or lose, a Hughes project was always spectacular in some aspect.

The Beginning of the End

The D-2/XF-11 was an expensive failure, but Hughes' biggest flop—literally—was yet to come. Like many follies, this one initially seemed to make sense: Pair Hughes with industrialist Henry J. Kaiser, creator of the Liberty ships, to build a gargantuan flying boat to ferry 750 troops overseas. To save money and use a non-critical resource, the HK-1 would be constructed of wood, using the Duramold process. A government contract was signed in 1942, but thanks to Hughes' perfectionism and procrastination, the aircraft was still unfinished at war's end. "It dragged on and on and on until it was just another useless aircraft," Burk says. "But it sure kept a lot of people busy."

After Kaiser bailed out of the project, the airplane was given several names: H-4, Hercules, Flying Boat. Popularly, it was known as the "Spruce Goose"—a misnomer since most of the wood was birch—or "Flying Lumberyard." In 1947, it was the subject of Senate hearings into allegations of war profiteering. Exonerated, Hughes crowed to the press, "I designed every nut and bolt that went into this airplane.... I have stated that if it fails to fly, I will leave the country. And I mean it."

Accordingly, the largest wooden airplane ever flown—20 percent larger than a 747—taxied into Long Beach Harbor in California later that year. While a crowd watched, Hughes rocked the eight-engine H-4 off the water and flew about a mile at the dizzying altitude of 70 feet. Thereafter, the HK-1 was kept ready to fly in a climate-controlled hangar. After Hughes' death (and torturous negotiations), the H-4 moved to a dome in Long Beach, where it became a tourist attraction. In 1992, it was disassembled and shipped to McMinnville, Oregon, where it was reconstituted as the centerpiece of the Evergreen Aviation Museum.

A Final Flirtation

The Flying Boat was the last airplane the Hughes Aircraft Company built. In 1949, Hughes paid \$250,000 to Kellett Aircraft for the rights to the XH-17, an experimental heavy-lift helicopter funded by the Air Force. Nicknamed the "Flying Crane" after Hughes Aircraft bought it, it was equipped with a 130-foot, two-blade rotor. Two Allison J-35 jet engines, modified by General Electric to act as compressors and designated TG-180s, fed compressed air through the hollow rotor blades to the tips, where fuel was ignited in burners to produce thrust. The rotors turned at a leisurely 88 rpm, but the effect was monstrous.

"Flames began to shoot out the tip burners, making a gigantic Fourth of July pinwheel," the Los Angeles Times reported in 1952, when Gale Moore made the first official flight off the Hughes runway in Culver City. "From 50 feet away, the whoosh-whoosh of the whirring blades sounded like hundreds of artillery shells in flight.... Then, with a great, bracing quiver, the helicopter raised itself from the ground, its four wheels at the end of its stork-like supports hanging free. The noise was numbing."

Moore accumulated 10 hours of flight time before the program ended in the mid-1950s. Although a follow-on Flying Crane program failed for lack of funds, helicopters turned out to be the key to a profitable future for Hughes Aircraft. Hughes himself, though, had no interest in rotary-wing technology, and the first flight of the XH-17 was the last time he visited the helicopter factory.

Hughes died on April 5, 1976. Fittingly, he was aboard a Learjet 25B at the time.

With his Hollywood good looks, Hughes left a trail of broken hearts and abandoned airplanes throughout his long and strange life. His last gasp was the long-rotored, stilty-legged XH-17 heavy-lift helicopter (bottom), the only aircraft he did not fly himself.







Vou ready for this?" the earphones inside my helmet crackled. It was a cold, moonless night over Texas and I was at 1,200 feet in a jet-black Bell 407 helicopter with Scott Baxter, an instructor with the Fort Worth-based Bell Helicopter Training Academy. From the left seat Baxter was teaching me the finer points of flying with night vision goggles, and it was time to demonstrate their usefulness during one of the more hair-raising events one can experience in a helicopter: autorotation after a simulated engine failure.

Well, was I ready? I had come to Bell's training facility to sample the thrills and chills of flying with night vision goggles. Bell's school is one of only two approved to teach civilian pilots like me how to fly with NVGs. I also wanted to learn why, over the past three decades, pilots have both praised and cursed the devices.

ARE LIGHTING THE WAY FOR MILITARY—AND NOW

CIVIL—FLIGHT CREWS. BY JOHN CROFT

But I didn't come to drop like a rock into the Texas scrub. Fortunately, Baxter had 1,500 hours of NVG time, much of it in situations much more demanding than this, so I nodded: Ready. Simulating engine failure, Baxter chopped the power and the bottom fell out.

There's an old adage instructors use when they teach night flying: If you lose your engine, switch on your landing light and turn toward an area that's dark—presumably there are no houses there. If you don't like what you see when the ground comes into view, turn the light off. There's truth in the dark humor: You can't see the touchdown area with the landing light until you're about 100 feet above the ground, too late to change course very much and almost too late to halt an unpowered helicopter's steep descent.

Baxter planned to show me how

Using night vision goggles, a Border Patrol flight crew scans a highway and railroad track in the desert just west of El Paso, Texas (above). An Australian C-130 crewman in Iraq delivers medical supplies by starlight (right).

NVGs change the equation. But to drive home his point, he wanted me to experience autorotation the old-fashioned way: with the unaided eyeball. So as we plummeted toward a landing at about 2,000 feet per minute, my job was to scour the depths until the landing light revealed whatever we'd be landing on. For an autorotation, you first drop rapidly, so airflow through the rotor disc increases rotor speed, then you convert the rotational energy to lift by pulling up on the collective control to increase the pitch of the blades. Finally, at just the right height above touchdown, you flare—pull the helicopter's nose up with the cyclic control. Start too low and too late and you hit the ground hard. Start too high and too early and you run out of rotor blade energy and hit harder.

Having flown with the NVGs on for only 20 minutes, I already missed them: I couldn't see anything. What looks like black emptiness to the naked eye is revealed in startlingly bright detail with NVGs. Earlier, Baxter had flown over

a dark patch at 1,200 feet and had me view what looked like a large puddle of ink, possibly a good spot for an emergency landing. After clicking my NVGs into place, I could see that the ink was actually a lake with a bridge running across it. And there were fine ripples on the surface of the water, indicating wind direction.

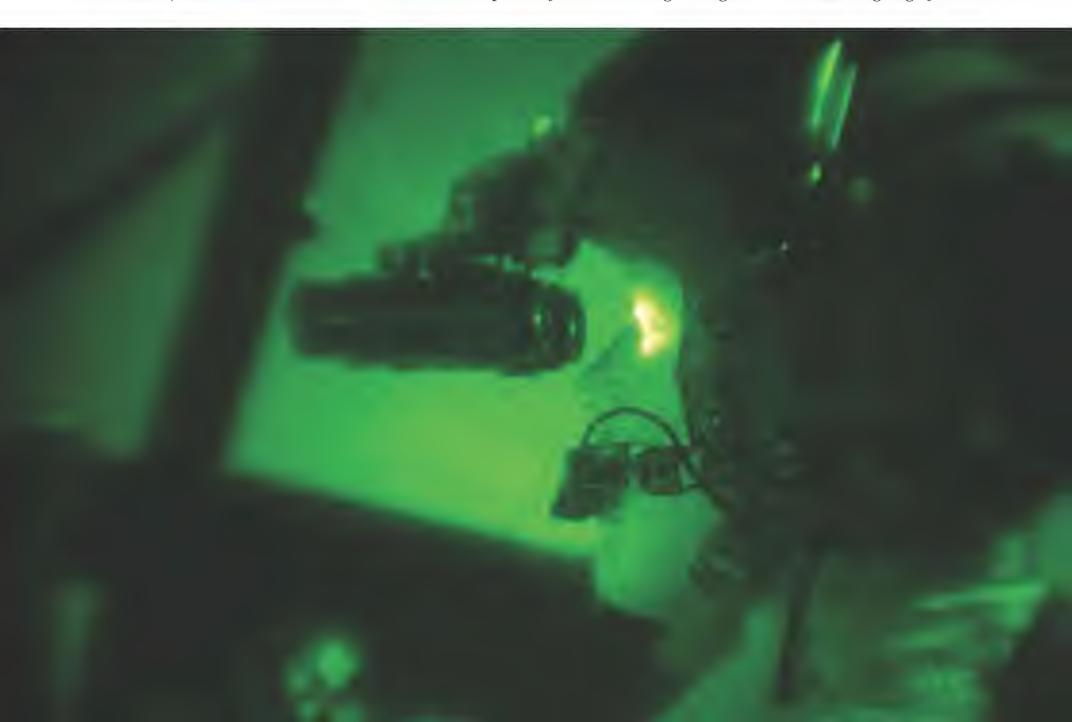
I could see the lake, bridge, and ripples because the NVGs extended my visibility range from 690 nanometers, the high end for the human eye, to about 930, which is in the near-infrared region of the electromagnetic spectrum. A broader range renders visible objects illuminated by scattered light from natural sources—starlight, chemical reactions in the upper atmosphere, and auroras, for example—as well as objects lit by artificial sources, like city lights, headlights, fires, and flares.

The moment of enlightenment comes when you look into the darkness with NVGs and see a circular 40-degree emerald-green field of view in which night becomes not quite day but something

like twilight. Though Baxter calls it "looking through a toilet paper roll," the view is quite engaging, despite the bulk of a flight helmet with an additional 1.2 pounds of hardware hanging off the front.

Before we cranked up the Bell 407, we preflighted our NVGs, adjusting the independent horizontal and vertical alignments of each tube, testing the electrical connections to the battery pack, and focusing the goggles on light sources and other objects in the waning twilight outside Bell's Fort Worth facility. We took off and buzzed along a river, through some fields and up and over a line of trees, a treacherous route made less stressful by the goggles and by Baxter's knowledge of the area. The pulse-pumping surreal experience made it clear to me that NVGs can lead, or, like a siren's song, lead astray.

"People think they're Superman," says Joe Roberts, chief of the flight instruction branch for the U.S. Army at Fort Rucker, Alabama. "It's like watching TV—the obstacles going by the air-





This second-generation AN/PVS-5 was based on a design for ground troops.

plane don't seem real like they do in the daytime." Roberts says this kind of illusion is one good reason why Army warrant officers get an initial 30 hours of NVG training at Fort Rucker, plus an "absolute minimum" of another 10 hours when they get assigned to units in the field.

Education is the tool of choice to counter the Superman syndrome, both in the armed forces and at Bell. The company's week-long NVG course, created by Baxter and C. "Mac" McMillian, Bell's chief flight instructor, demonstrates to students in the civilian sector both the advantages and the limitations of NVGs. Pilots can take the \$8,500 package, which includes six lectures in the classroom and at least 7.5 hours in the air at night in the school's three NVG-equipped helicopters, before they take jobs with police or emergency medical services (EMS) operations. Baxter briefed me on the schoolwork before we flew, describing classroom modules on everything from cockpit lighting to mission planning.

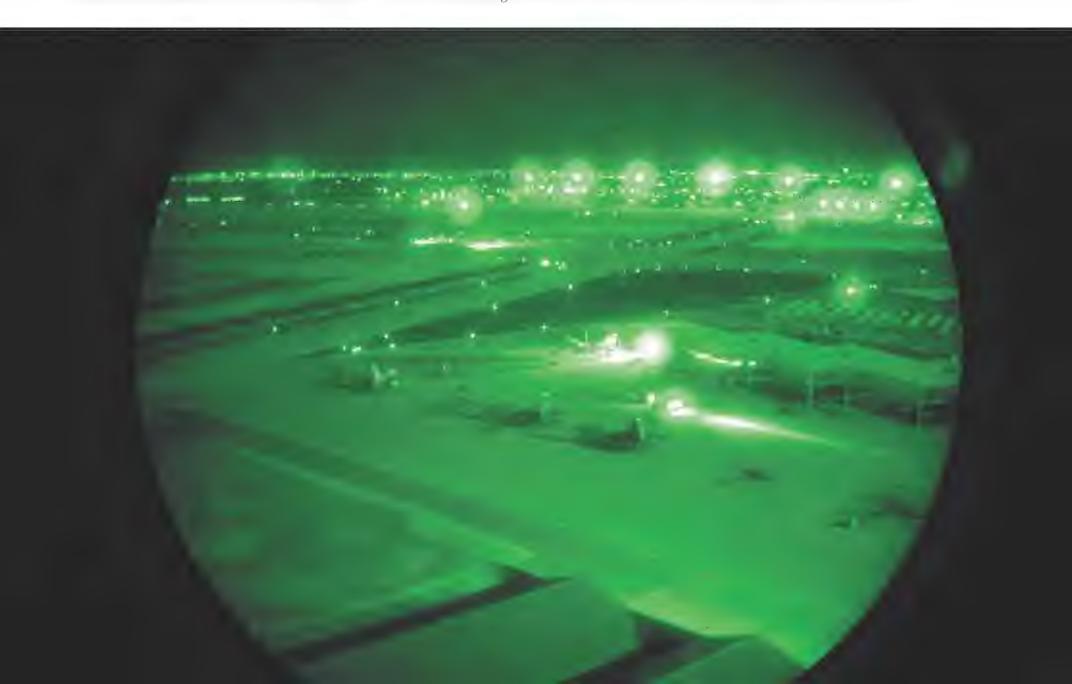
Information in Bell's course is largely drawn from the harsh lessons that the military, particularly the Army, learned when it first put NVGs into aircraft in the 1970s. "They gave them to us and said, 'Go fly,' " says Roger Anderson, a former Army helicopter pilot who is now a marketing manager with NVG maker ITT Industries.

While archaic by today's standards, the first aviation goggles, called PVS-5s, were quite advanced compared to the IC-16 infrared night scopes, known as Gen 0 (generation zero) technology,

that appeared in the field in the 1950s in order to gain the tactical advantages of being able to see an enemy who couldn't see you. Since that time, night vision systems took two paths: Infrared sensors like the IC-16 evolved into forward-looking infrared (FLIR) systems, which include a bulky sensor pod outside the aircraft and an electronics box and display unit inside, while goggles evolved into image intensifiers. FLIRs, while well suited to view details of a target area from a head-up or panelmounted display, are not good candidates for piloting, partly because the view doesn't follow the pilot's line of sight.

In Vietnam in the 1960s, ground forces used unwieldy Gen 1 image intensifiers called starlight scopes, in which three image intensifier tubes were stacked end to end, like flashlight batteries. Gen 2 came out in the 1970s with the introduction of the microchannel plate, which eliminated the need to stack multiple intensifiers and paved

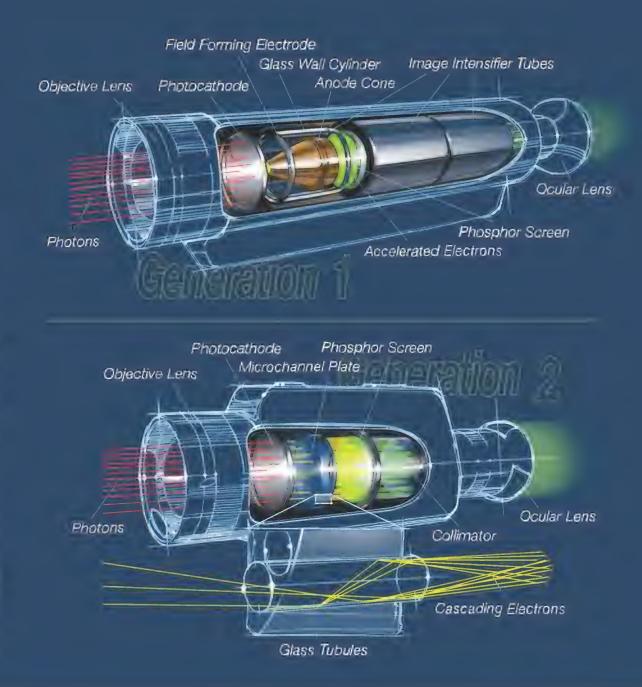
The ramp at Luke Air Force Base, Arizona, as seen from the control tower. Soon military controllers will use NVGs at blacked-out locations.



The Physics of NVGs

NVGs amplify ambient light that is virtually undetectable to the naked eye and convert it to the visual spectrum on two-dimensional screens in front of each eye. In each tube of the goggles, photons reflected from an object enter through optics that focus the image of the object on the front side of a gallium arsenide photocathode. The photocathode ejects electrons from its back side in proportion to the amount of photons coming in from the front. The process is accelerated by an electrical field that is generated by two AA batteries mounted on the helmet.

The freed electrons ricochet through a microchannel plate, a thin wafer the size of a quarter with 10 million tiny glass tubules offset eight degrees from the incoming stream and coated on the inside with a material that releases additional electrons with each ricochet, amplifying the input signal thousands of times. The cascading electrons light up a phosphor screen in the eyepiece, painting just an inch or so from the pilot's eyes a representation, in shades of green, of the scene outside.



the way for compact helmet-mounted goggles like the PVS-5.

While the technology had improved, inexperience with human factors issues in night vision systems for aviation proved troublesome and often disastrous. Unlike today's NVGs, the PVS-5 clamped onto the pilot's face like a weighty scuba mask. In order to see the instrument panel, crews had to either focus one side of the goggle outside and the other on the instrument panel, or have one pilot focus outside and one inside.

Dutch Fridd, an EMS pilot and the first civilian appointed as an NVG instructor by the Federal Aviation Administration in 1999, began using the full-face PVS-5 in 1978 in Army helicopters. Fridd says crews went out with no guidance on the use of the goggles and no information about their performance in various weather conditions. Some pilots were refusing to fly and others who tried had trouble

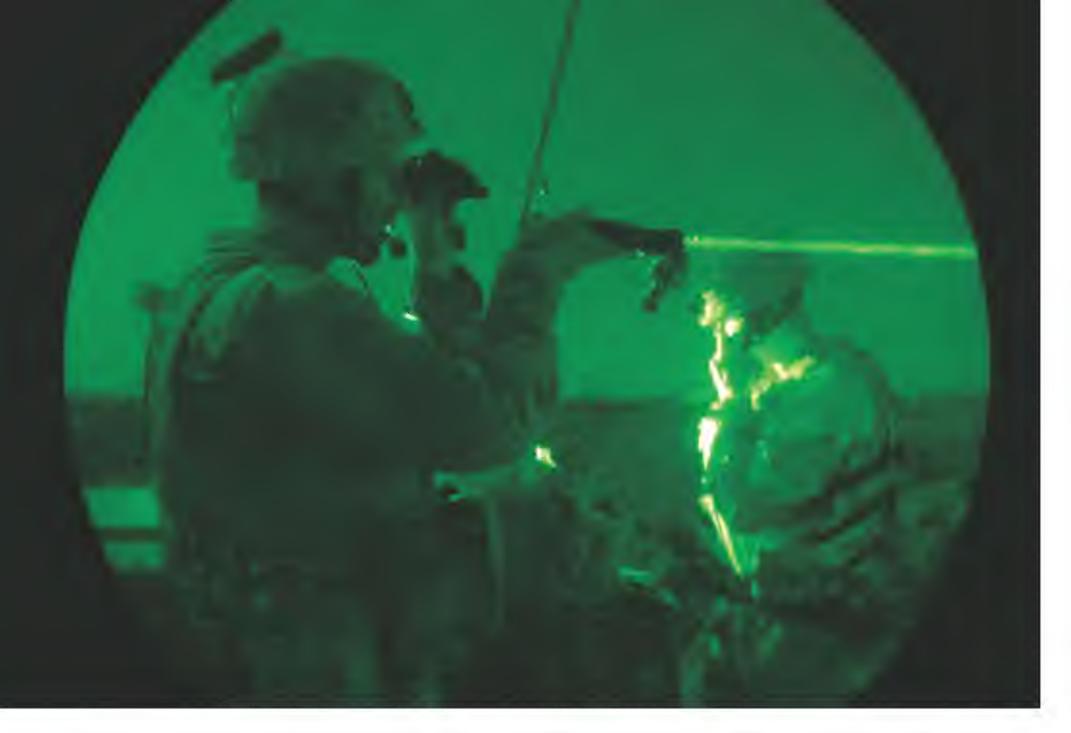
controlling their helicopters or became ill from spatial disorientation. "During formation takeoffs, you had people flying backwards, sideways," Fridd says. "Others were hitting wires or trees." During his first 40 or 50 hours of PVS-5 flight time, he "absolutely detested it," he says.

But the pilots felt that they had to make it work: "The only way we'd survive [in hostile airspace] would be down in the trees, and we needed goggles to do that," Fridd says. A major threat for helicopters then, as now, was shoulder-launched missiles. Anderson says the PVS-5, though not designed for aviation, gave the Army a real edge. "It didn't take long for the strategists to figure out that we'd have a huge advantage working at night," he says.

Both Fridd and ITT's Anderson say pilots eventually discovered that cutting away some of the casing below the PVS-5 eyepiece would give them a much more comfortable view both out-

side and inside the cockpit, a finding that was later built into Gen 3 units, which sit an inch or so away from the eye. Also problematic at the time were instrument panel lights that swamped the NVGs with photons, making it hard to see the outside scene. Pilots dealt with the problem by turning off the instrument lights and illuminating the panel with chemical light sticks—"chemsticks," which emitted light in a narrow part of the spectrum. Today's NVGcompatible aircraft emit light in the blue end of the visible spectrum or have glass filters to cancel out the white lighting of older cockpits.

In 1980, Operation Eagle Claw, the attempt to rescue 53 U.S. hostages in Iran, proved disastrous when an RH-53 helicopter collided with an EC-130 refueling aircraft, killing eight soldiers. The mission had been planned as a night operation, but pilots had received only 15 hours of NVG training, and instrument panels had to be taped over



Pointers and illuminators that project infrared light, invisible to the human eye, enable ground commanders and combat controllers in Iraq and Afghanistan to identify targets and designate them for pilots with NVGs.

to prevent interference with the PVS-5s. As is often the case, disaster spawned research.

Gen 3 NVGs, which introduced image-enhancing gallium arsenide

This bulky 1960s night vision device amplified skyglow and permitted U.S. troops to spot objects three-quarters of a mile away.



photocathodes, longer life (10,000 hours, up from 2,000), and other enhancements, came into service in the early 1980s and, when combined with experience gained in training and in de-

signing compatible lighting, proved themselves in night operations in the 1991 and current Iraq conflicts. Almost every U.S. military aircraft is now equipped with compatible lighting, and crews are training to use NVGs for every night flight. Goggles continue to improve, though the technology is still called Gen 3.

Widespread use in the military has slowly begun driving NVG devices into civilian aviation; when military pilots retire or finish their tours, they bring their Gen 3 experience to the private sector. Lately,

petroleum companies, medical transports, pipeline patrol outfits, and even mosquito-spraying companies are clamoring to certify their aircraft and crews to fly with NVGs.

The FAA, not wanting to duplicate the entire history of NVGs in the military, 10 years ago began developing guidelines for civilian use. Unlike police units, civilian operators must get FAA approval for their goggles, interior lighting systems, and training programs. On tap for next year are minimum standards for goggle performance, in part to prevent pilots from using substandard night vision equipment now available from "Eastern bloc countries," says FAA rotorcraft specialist William H. Wallace. Bell uses NVGs made by Northrop Grumman; that company and ITT Industries are the principal U.S. manufacturers of the devices.

Until the civilian rules are in place, FAA approvals are granted on an individual basis and can be somewhat ad hoc. In 1999 Rocky Mountain Helicopters became the first air taxi company to earn FAA approval to use NVGs for its EMS helicopters. The company

later was bought by Denver-based Air Methods, where Fridd is an NVG instructor.

Chuck Antonio, a former Navy fighter pilot and flight surgeon who later helped develop the NVG training programs for various aircraft in the Navy, Marines, and Air Force, leads a government and aviation industry committee that is advising the FAA on formulating the rules. Based on the military's experience then and now, Antonio believes most NVG accidents are caused by inadequate training, poor crew coordination, and flying too fast for the limited contrast and visual cues that NVGs provide. Antonio studied Air Force, Navy, and Marine accidents in fast-moving jets like the F/A-18, AV-8B, F-16, and A-10 and found that pilots would neglect their flight instruments in favor of the emerald world outside and become disoriented.

The military's safety record today is probably better than it was in the early days, but it's hard to tell. From 1980 to 1989, the Army alone had 79 accidents and 32 fatalities involving helicopter crews wearing NVGs, prompting an investigation by Congress, and the Marines had a similar rash of crashes. As a result the military delved into the human factors issues behind the incidents and created specialized night

vision training programs starting in the early 1990s. As for the safety record, experts like Antonio say it's difficult to get a feel for trends since the military is conducting more and more complex night operations with goggles. "This undoubtedly leads to more risk and therefore a greater opportunity for mishaps," says Antonio.

A search of the National Transportation Safety Board's accident records for civilian or government-owned aircraft turned up only one accident where NVGs appeared to play a role. A crash of a Bell OH-58A on October 22, 2001, in Bartow, Florida, killed the police department pilot and observer when the

helicopter hit the ground in a swampy area one mile from the departure airport. Though the NTSB found goggles in the wreckage and deputies who had flown with the pilot stated that he had "always used" NVGs for night flight, including landings, the board ruled that continued flight into instrument weather conditions and failure to maintain altitude were the probable causes, not the goggles. The sparse accident record may be a result of the newness of NVGs to the sector, or a byproduct of missions that are less sporty than the military's. "We're not flying nap of the earth, just using [the goggles] to avoid obstacles in getting from point A to point B," says Fridd of the EMS community. Baxter, a member of Antonio's advisory committee, says the industry wrongly believes that pilots with NVGs will fly into clouds and have no clue how to get back out. "It gets back to the training issues of how we identify poor weather," he says. "We teach techniques that help you avoid it." (Bell, which has been training police pilots how to use NVGs for years, got FAA approval to teach civilians in 2002.)

Those weather-avoiding techniques emerged in part from experience in combat operations in the Persian Gulf. In 1987, as a new Army pilot with 17 hours of NVG time, Baxter took part in a classified mission called Operation Prime Chance, designed to escort Kuwaiti oil tankers out of the Persian Gulf during the Iran-Iraq war. The mission called for crews to fly armed OH-58 helicopters at night, 20 feet above the water, to protect the ships from attacks by smaller boats and to deter the Iraqis from laying mines. "It wasn't doable without goggles," Baxter says. Some say Prime Chance, which ended after two years, was the first successful night combat operation performed entirely with NVGs.

The mission gave Baxter 1,100 hours of flying time, 500 with NVGs. That experience was of great comfort when, during my autorotation, I looked in vain for the 407's landing light to strike gold or hit rock.

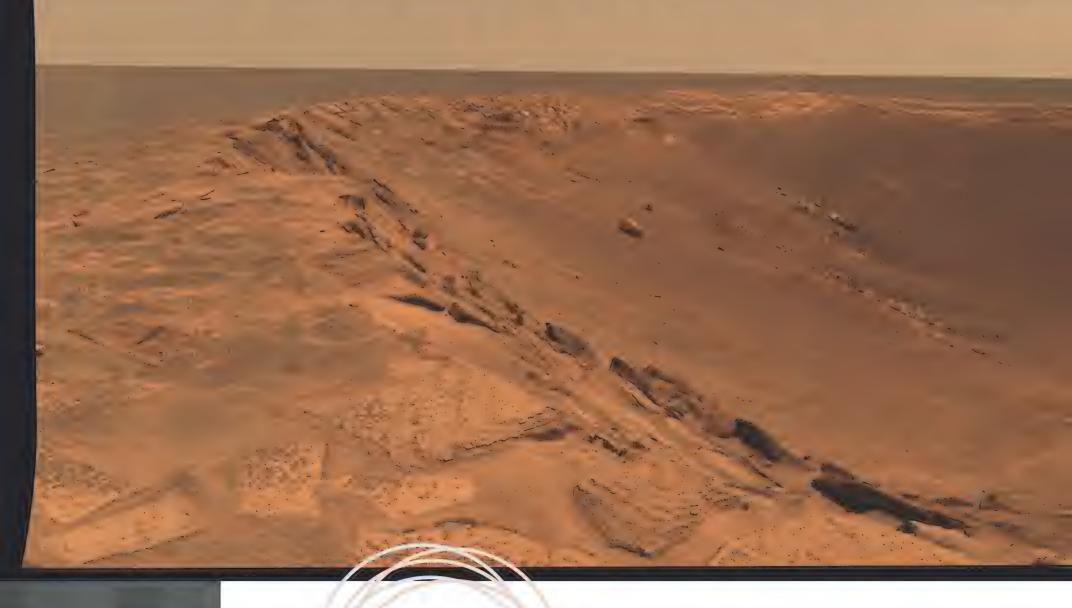
No sooner had I called out "I have it" (the ground in plain sight) than Baxter, who with his NVGs knew where he was going all the time, yanked the rotor pitch control up just before we plunked down and skidded 100 feet down Bell's practice runway, a landing that looked easy because of the right training, the right equipment, and the NVG's magic emerald image.

Then Baxter, like every good pilot, issued the requisite self-critique. "I coulda used even less runway," he said.

What the modern A-10 pilot is wearing: Lt. Shawn McManus sports light, compact, third-generation NVGs. Note the instrument lighting, which is NVG-compatible.



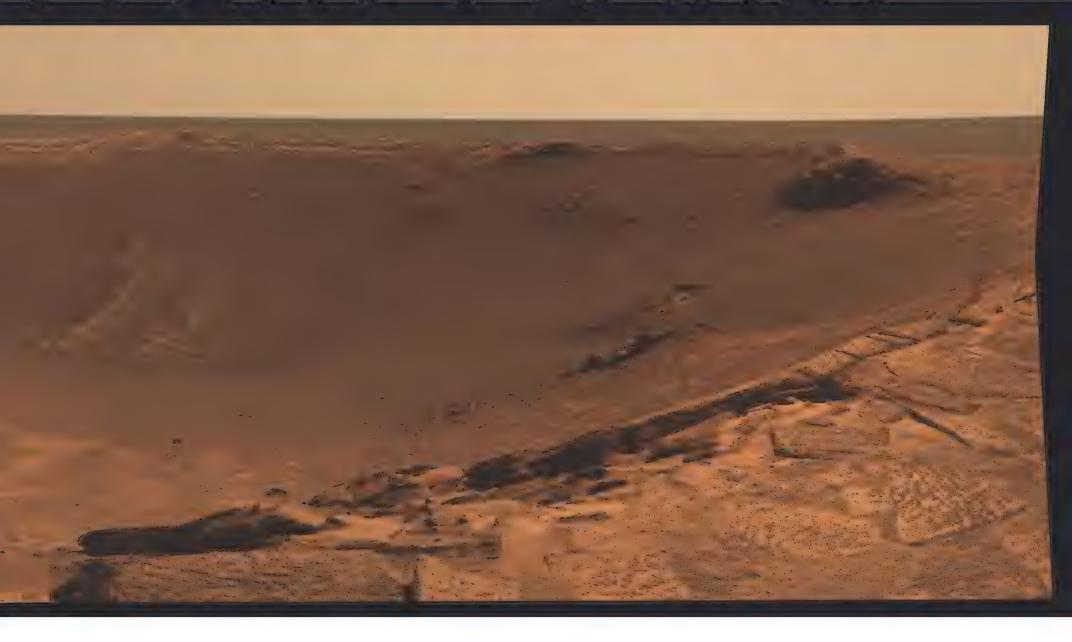
SCENES FROM



ust landing at all was a victory. The Jet Propulsion Laboratory engineers who built the Mars Exploration Rovers remembered all too well that they'd blown it last time, that over the course of 10 weeks in 1999 they'd lost two spacecraft and in the process nearly scuttled NASA's Mars exploration program. So when the identical twin rovers, *Spirit* and *Opportunity*, rolled to a stop inside their protective airbags on opposite sides of the planet on January 4 and January 25, then sent back panoramic photos confirming their safe landing, half the battle was already won.

The other half was finding evidence that water once existed on Mars. Life requires water, biologists tell us, and planetary scientists have made water the central preoccupation of Martian research. *Spirit* landed in the vast, nearly flat Gusev Crater, which is thought to have long ago been a lake (see "Next Stop: Gusev Crater," Dec. 2003/Jan. 2004). *Opportunity* was sent to a plain named Meridiani to search for hematite, a mineral that on Earth typically forms in the presence of water. With their collection of high-resolution cameras, microscopic imagers, drills, and spectrometers, the rovers were well equipped for what project sci-

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entist Steve Squyres of Cornell University called "the coolest geologic field trip in human history."

By March, Squyres and his colleagues had what they were looking for. *Spirit* found no lake deposits at its flat, rocky landing site, but by sheer luck, *Opportunity* landed in a crater gouged out of the dry landscape eons earlier by a meteorite impact. Photos of the crater's inner rim showed an outcrop of exposed rock, the first ever seen on Mars. And a closer look at the texture and chemistry of the layered rocks revealed that long ago, they had been underwater for an extended period of time.

Continuing on, the rovers found evidence of ancient water in other locations, to the scientists' delight and no one's great surprise. In May, *Opportunity* rolled up to the edge of a deep, stadium-size crater called Endurance (above, with rippled sand dunes at the bottom), then ventured inside for a closer look, while *Spirit* set new distance records for a Mars rover. A geologist undoubtedly could have done the job much faster, but nobody seemed to mind. The robots accomplished everything they were asked to do, and more.

etting a spacecraft down on Mars is a tricky business. All that mission planners could do ahead of time was pick an area that, from their scrutiny of orbital photography, altimetry, and other data, looked relatively safe, then hope for the best. Both *Spirit* and *Opportunity* came down within six and 15 miles, respectively, of their target points, in the center of predetermined elliptical landing zones. Their parachute descent was monitored by radio signal while onboard cameras took pictures of the approaching surface, making these Mars landings the most closely tracked ever. The Mars Orbiter Camera, which has been circling the planet since 1997, even took pictures of the landers after they touched down, tiny pinpoints of white against a dark surface.



Engineers practiced with a mockup rover at JPL before tackling Endurance Crater. The rover managed rocky slopes of up to 25 degrees with no problem. Below: Spirit looked back at its landing platform for this photo of Gusev Crater.



Spirit landed on a rolling plain—now renamed the Columbia Memorial Station—that looked similar to the landing sites for the Viking and Mars Pathfinder spacecraft, but with fewer large boulders. Three hundred fifty yards to the northeast, orbital photos showed a 230-yard-wide crater, dubbed "Bonneville" after a prehistoric lake in Utah. One and a half miles to the southeast were the Columbia Hills, named for the astronauts who died in that shuttle. These would become *Spirit*'s primary destinations.

Three weeks later and 6,000 miles away, *Opportunity* came to a bouncing stop in a shallow, 70-foot-wide crater called Eagle. Dismay at landing in a hole, which obstructed the scientists' view of the horizon, soon gave way to joy when *Opportunity*'s panoramic views showed exposed bedrock in Eagle's rim. The rover would spend nearly two months poking around those rocks, examining the layers of geologic history on display and nailing down the evidence for past water. Few scientists would have guessed it beforehand, but craters now appear to be the perfect place for a Martian explorer to land. In fact, after *Opportunity* left Eagle, JPL engineers sent it into an even deeper hole, after ground tests showed that the rover could climb back out again.

generated red line,
superimposed on descent
imagery from the Opportunity
lander, shows the spacecraft's
bouncing path after its
airbag cocoon hit the Martian
surface on January 25.
Eagle Crater, at far right,
is about as wide as a typical
suburban front yard.







Inside Eagle Crater, Opportunity peered over the white fabric of its airbags and snapped a photo panoramic camera (above). The dark squares are solar panels for generating power. At upper right on the crater wall is the telltale outcrop of rock that held clues to Meridiani's watery past. Impressions of the spacecraft's airbags stamped in the fine Martian soil (left) were more than just footprints—they gave scientists key information about soil properties before the rovers ventured out to explore an unknown surface.

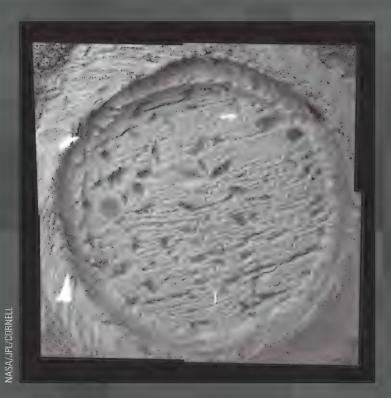


The round "blueberries" in this false-color Opportunity image were found embedded in Eagle Crater's rocks. Rich in hematite, they are thought to be mineral concretions formed inside water-soaked deposits.



Who needs a shovel? Engineers devised an ingenious way for the rovers to dig into Martian dirt (above): locking some wheels while spinning others. Taking a page from mission control in Houston, which serenades astronauts each morning in space, JPL project managers played Bob Marley's "Trenchtown Rock" to begin one day of digging.

Right: Opportunity's Microscopic Imager peered into a rock at Endurance Crater, where the rover had bored a shallow hole less than two inches wide. The thin horizontal layering is evidence of past water.





he rovers were the first spacecraft sent to Mars with tools powerful enough to answer fundamental questions about local geology—for example, whether the rocks are sedimentary or volcanic in origin. Their panoramic cameras have about the same resolution, or ability to see detail, as the human eye. A miniature thermal emission spectrometer (Mini-TES) can make infrared heat maps and identify minerals in the surrounding terrain. And unlike the stationary Viking landers of the 1970s or the smaller and far more limited Mars Pathfinder of 1997, *Spirit* and *Opportunity* can wander far from their landing sites.

Images and spectral data systematically gathered from the ground and from Mars orbit in the days following landing helped scientists plan a detailed campaign of exploration for the two rovers. If either came upon an oddly textured rock or a patch of discolored soil, it could be added to the list for future study.

In contrast to orbital missions, "study" in this case meant detailed, close-up examination. At the end of each rover's extendable arm, more instruments, including a microscopic imager, a drill for getting at fresh material beneath the weathered surface of a rock, and more spectrometers, determined the chemical and mineral makeup. In keeping with NASA's tradition of acronyms, the drill had a geeky name: the rock abrasion tool, or RAT. It was common to hear project scientists talk about "ratting," or drilling into, a rock two "Sols" in the future—a Sol being a 24-hour, 39-minute Martian day.

Soon after *Opportunity*'s landing, the rover was busily ratting into rock outcrops, where it found BB-size spheres, formed in the distant past by minerals dissolving out of Martian rock. The scientists nicknamed these "blueberries." An instrument called a Mössbauer spectrometer, tuned to discriminate among various kinds of iron, identified a mineral called jarosite—further evidence of water. Yet another spectrometer revealed sulfur-bearing salts that typically form in wet environments. The ripples and layering in the rocks, along with other clues, gave the researchers more confidence in their conclusion that the rocks in Eagle Crater had once been drenched with water.

Weeks later, inside a larger crater called Endurance, *Opportunity* found additional signs that the planet had once been wet. When it looked as though *Spirit* would come up empty, in April scientists announced that it, too, had found traces of past water seepage from a crack in a half-buried rock called Mazatzal. Not as dramatic as *Opportunity*'s salty sea, maybe, but evidence just the same.



Spirit "rats" a rock called Adirondack.

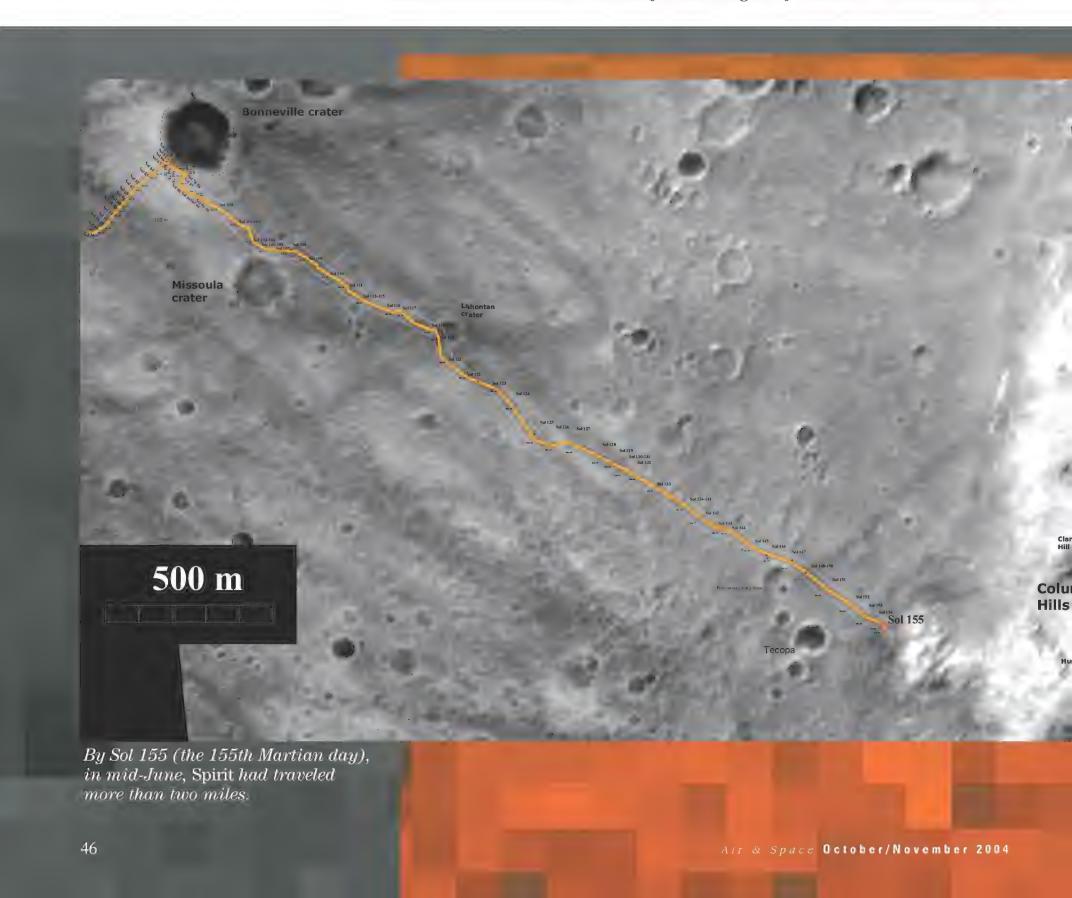


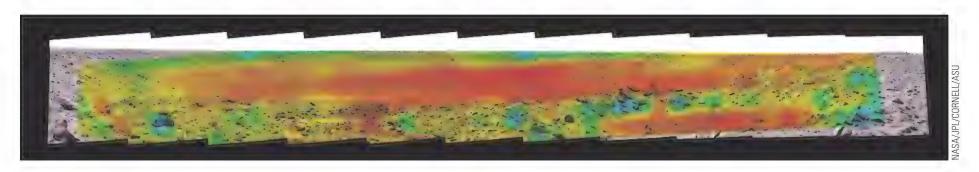
BB-size grains abound in Meridiani's rocks.

he travels of *Spirit* and *Opportunity* mark a new age of Mars exploration. Not only are two rovers operating simultaneously on the planet's surface for the first time, but the expedition uses data and radio relays from three more satellites in orbit—Mars Global Surveyor, Mars Odyssey, and Europe's Mars Express. The last arrived in December for its own extended study of the planet, and immediately made the first direct measurement of water in the planet's polar cap. In 2004, Mars was a busy place.

High-resolution pictures from the Mars Global Surveyor were key to mapping the rovers' route (see below). *Spirit* landed not far from Bonneville crater, which project scientists picked as an early destination. When Bonneville proved a disappointment (no rock outcrops), the rover set off on a long journey to the 330-foothigh Columbia Hills, nearly two miles away. The attraction for scientists was that these rocks are higher, and likely to be of a different age, than those near the landing site. *Spirit* reached the base of the hills in mid-June, and was still exploring them in late summer.

The Mars rovers were built to last at least 90 Martian days, but project officials always knew this was just "the warranty period," as JPL engineers put it, and that the machines were likely to last longer. By the time the nominal 90-Sol



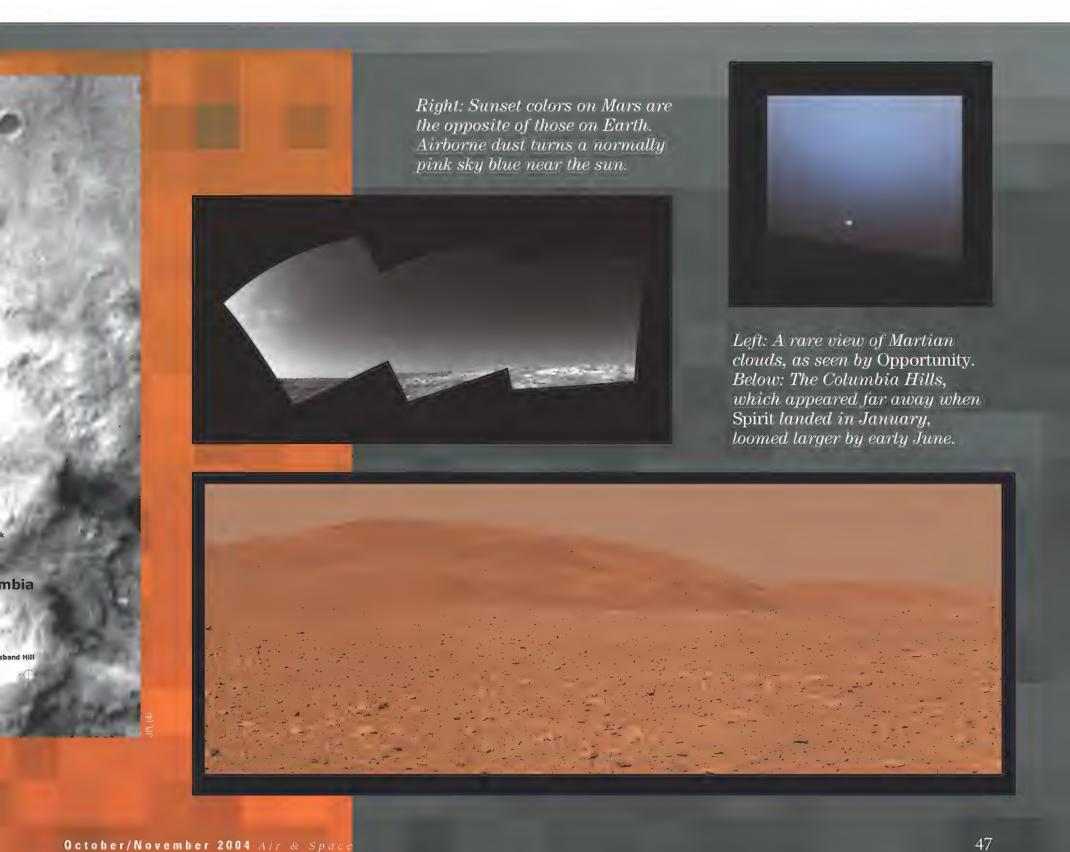


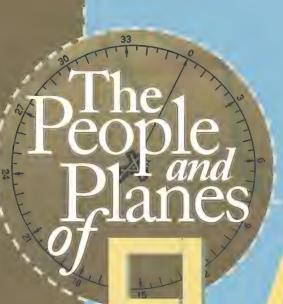
mission was over, the odometer on the golf-cart-size Spirit read 637 meters—about 4/10 of a mile. By late summer the rover had traveled several times that distance, and NASA had decided to extend the mission—as if shutting down two healthy Mars rovers was even an option.

Meanwhile, engineers back on Earth were preparing more Mars missions, which will be launched in 2005, 2007, and 2009. With about as much land mass on this dry planet as Earth has on its watery surface, Mars still offers plenty of territory to explore.

—The editors

A thermal emission spectrometer on board Spirit recorded this heat map of Bonneville Crater on a May afternoon, about 1:35 Martian time. Red areas are warm, blue areas cooler. The temperature map also gives clues to the composition of the rocks.





ABOB

Grassroots aviation gets a second chance at this historic airport. hy Marshall Lumsden

K Photographs by Chad Slattery

rom the air you can clearly see that the new Flabob Airport is taking over the old one. Lines of shiny new hangars have sprouted among the old buildings, and the runway, taxiways, and ramps have a fresh look to them.

The old Flabob started its life in 1943, when pilot Flavio Madariaga and his business partner, Bob Bogen, purchased a dirt airstrip nestled between the small town of Rubidoux and the city of Riverside in southern California. The two men combined their first names to create "Flabob," but it was Madariaga's personality and talent that shaped the airport. For 40 years he built it up, often with his own hands, making it a mecca for people who are passionate about building and flying airplanes. When Madariaga died in 1984, his son, Don, took over.

During the next 16 years, Flabob fell on hard times and seemed destined for closure, but in 2000, as a new century began, so did a new Flabob. The Thomas Wathen Foundation, founded by Thomas W. Wathen, the former head of the Pinkerton security company, purchased the 82-acre airport, saving it at the 11th hour from commercial real estate developers. Today, the Wathen Foundation uses the newly renovated airport and its resources for educational programs, enlisting aviation to teach science, math, and technology to young people. And a small general aviation community still calls the airport home.



Despite all the spiffing up, Flabob still has a vintage charm, thanks in large part to Madariaga's wheelings and dealings. Not only a master machinist and a skilled pilot, Madariaga was also a brilliant scrounger who bought, sold, and traded airplanes—and nearly everything else. An old gas station canopy that he salvaged still serves as an open-air shelter for aircraft. And he once paid a dollar for a building that had housed a defunct nightclub and moved it to the airport, where he reopened it as a nightclub, restaurant, and social center.

Once, while flying over the southern California desert, Madariaga spotted some men stacking what looked like lumber, so he landed his Stearman to see what they were doing. It turned out that the area had been a training ground for General George S. Patton's U.S. Army tank corps in 1942. The men had purchased as surplus the wood



from crates in which the tanks had been delivered. It was high-grade, one-inch oak, and Madariaga tried to trade the Stearman for it, but the men said they didn't know how to fly. Madariaga then threw in free flying lessons, closing the deal on the spot.

Don Madariaga (one of Flavio's four children) recalls the airport's spartan beginnings: "The old plowed-out runway was about 200 yards long. Only one building was there: the original hangar. When we first moved here, Dad put up a circus tent [which the family lived in] on a horse ranch next to the airport property. We were there for about a year until he could build a house." His dad, says Don, also constructed movie props for the film industry. "He made the vines that Tarzan used to swing on," says Don. "There was a big pond there with an overhanging tree, and he built a Tom Sawyer raft and the

NEV.

California's Flabob Airport has long been a haven for homebuilders. For the last eight years, Raymond Page, wife Marillyn, and daughter Darlene Heller (left) have been restoring a Piper Tri-Pacer. CALIF.
Flabob Airport
ARIZ.



The Flabob Airport Café has been serving breakfast and lunch to pilots and locals for more than 50 years.

One of the most beautiful restorations hangared at Flabob is a 1928 Stearman C3B owned by Ron Alexander. vines like he built for Tarzan, and we as kids used to swing on them."

When some buildings at nearby U.S. Army Camp Hahn were declared surplus, Madariaga tried to buy them, but rules stated they could be sold only to farmers and clergymen. Madariaga decided to pose as a farmer. "He did have a dog and a horse but that wasn't enough," says Don. "So he went and bought a donkey by the name of Napoleon and a wagon on the other side of town, and we hooked [the wagon] to the bumper of the car and towed it back to the airport. And I'd swat the donkey on the fanny, while dad was driving the car, to keep him moving [alongside the car]. Then he bought some chickens." The government finally agreed that Madariaga looked like a farmer, and he bid successfully on the buildings and moved them to the airport.

One of the buildings still houses the Flabob Airport Café, which has remained the social and communications center of Flabob. Open seven days a week from 7 a.m. to 3 p.m., the café's walls are covered with photographs of pilots and vintage airplanes.



Scale model aircraft hanging from the rafters stir gently in the draft from ceiling fans. Waitresses bustle by delivering cheesesteak sandwiches and biscuits with sausage gravy. The café is a portal to the old Flabob.

In a back corner, black-and-white photographs show Madariaga and his wife Bertha, or Bert, as everyone called her, posing by various aircraft. She is beautiful. He is movie star handsome, a cross between Clark Gable and Gilbert Roland.

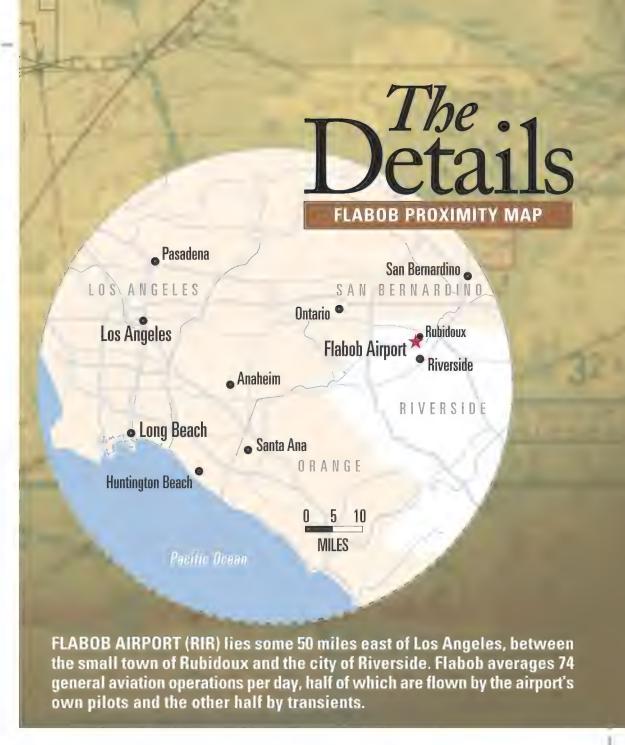
Situated some 50 miles east of Los Angeles, Flabob has long drawn aviation folks connected to the film industry. Legendary stunt flier Frank Tallman, who flew an airplane through a billboard in the 1963 movie *It's a Mad, Mad, Mad, Mad, Mad World*, had a hangar here in which he restored military aircraft to appear in movies. Tallman later hooked up with movie pilot Paul Mantz, who specialized in flying through buildings, and in 1961 the two founded Tallmantz Aviation at what is now known as John Wayne Airport, in Santa Ana, California.

For a while the Tallmantz payroll included aerobatic pilot Art Scholl; he later started a production company at Flabob, producing aerial photography and flying sequences for movies and television shows. Scholl was also a veteran airshow pilot, flying the *Pennzoil Special*, a highly modified de Havilland Super Chipmunk that is now on display in the National Air and Space Museum's Steven F. Udvar-Hazy Center in Virginia. (In 1985, Scholl, 53, died while filming an aerial sequence for *Top* Gun: After putting a Pitts S-2A into an intentional spin, Scholl never regained level flight and the airplane plunged into the Pacific.)

Some people have been around the airport so long that they seem to be part of the infrastructure, and they can fill you in on the rest of Flabob's history. Ray Stits, a pioneer in homebuilt aircraft, arrived here in March 1951. He was already well known for building the world's smallest monoplane, the Stits Junior, which he made because somebody told him he couldn't do it. Its wingspan is eight feet, 10 inches.

Once at Flabob, he outdid himself with the Stits Sky Baby, the world's smallest biplane, which has a seven-foot, two-inch span. Over the years at Flabob, Stits designed 14 aircraft for homebuilders.

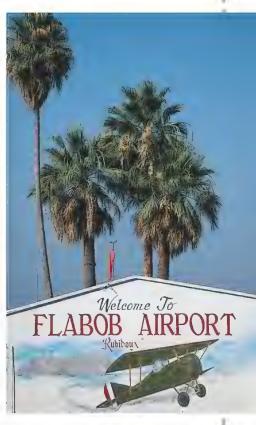
"Flavio built this place from scratch," says Stits. "You had to check for wild stray dogs



and cattle on the runway. There were four hangars here and a little cement-block office building. I got an empty hangar, doors [missing]. Okay, I can get that for 15 dollars a month? Here's my 15 dollars."

Stits was responsible for the Experimental Aircraft Association being organized by chapter. In 1953, he heard that somebody named Paul Poberezny in Hales Corner, Wisconsin, was starting an organization for homebuilders. He inquired about it. "Got a letter back," he says. "Two pages of bylaws. Thought about it for a couple of weeks, and it was five dollars membership. And, okay, here's my five dollars. Let's change the bylaws to provide for a West Coast chapter." Poberezny agreed, but said that Stits had to get 10 members signed up. "Got nine other people," says Stits. "Wrote back and said, Okay, you got Chapter One.'

Today, the EAA has almost 1,000 chapters worldwide, and Chapter One, which held its first meeting in 1954, has more than 500 members, many of whom live in other states and pay dues just so they can say they belong to it. A group of dissident Chapter One members formed another chapter at



A mural depicts the area's most prominent landmark: Mount Rubidoux, a 1,400-foot ridge that rises near the runway's end.



Krystal Bender inspects a Rans S-14 Airaile ultralight.



Based at Flabob since 1955, Ed Marquart designed the MA-5 Charger.



Pilot Charlie Webber lives on the airport in a mobile home.

Flabob a few years ago—Vintage Aircraft Association Chapter 33. The two chapters are now friendly, but each sponsors its own fly-in. Chapter 33 holds one with an open house in May; Chapter One hosts its event in September.

In 1971, after it had taken him four and a half years to get his Skycoupe certified by the Federal Aviation Administration, Stits gave up the airplane design business. "I had 15 employees then," he recounts, "and I would have [had] to start selling 90 airplanes a month to break even on it." Meanwhile, he had turned to developing a fire-retardant airplane fabric covering. He came up with Poly-Fiber, which today is the largest business at Flabob. At 83, Stits still flies his 1975 Cessna 182.

Stits' presence at Flabob drew others interested in aircraft design, including Ed Marquart, a private pilot who arrived from Pennsylvania in 1955. "I had heard about Flabob and Ray Stits through the EAA publications," he says. "I went to work for Ray...for about a year and a half, doing tooling, welding, and setting up fuselages." While still working for Stits, Marquart worked nights and weekends on an airplane he had designed himself. He called it the Marquart MA-3. It turned out to be the predecessor to the popular MA-5 Charger, a graceful, swept-wing, two-place, opencockpit biplane for which about 450 sets of plans have been sold. Of those, 100 are being built, and 85 are flying.

Marquart's hangar is chock full of future projects. One is the fuselage of a 1929 Driggs Skylark biplane, one of only 21 ever built. He swapped an MA-4 kit for it with a man from Kentucky, who agreed to bring the fuselage across country on a trailer. Says Marquart: "I haven't finished this yet, and he hasn't finished the MA-4 yet, and that was about 1968."

Clayton Stephens has hung around Flabob longer than just about anybody else. He learned to fly here in 1945, and logged a lot of time on Civil Air Patrol searches.

Stephens and a fellow CAP pilot, George Ritchie, built a business at the airport fixing up airplanes and reselling them. When Ritchie's wife Margaret showed an aptitude for aerobatics, they worked together with Marquart to modify a Taylorcraft high-wing monoplane for her. But the modified craft couldn't match the performance of the Pitts biplanes frequently used by aerobatic pilots, so Stephens and Ritchie built the Akro. It was the first low-wing monoplane

constructed in the United States especially for aerobatics. With the Akro, Margaret Ritchie won the national women's aerobatics title in 1966. The canopy was designed to accommodate Ritchie's beehive hairdo, and when she was killed while flying the Akro in 1969, the sturdy little aircraft was cut into pieces and buried with her.

For a few years, Stephens continued to sell plans for Akros. "There were a couple dozen made, and newer variations of it are still in competition," he says. The late Leo Loudenslager, a seven-time U.S. National Aerobatic Champion, modified an Akro to create the Akro Laser 200, which is now on display at the Steven F. Udvar-Hazy Center.

Look out on Flabob's ramp and you might see Bud Bell tooling up in his restored World War II Jeep. He and his wife Joyce seldom miss breakfast at the café. Bell was a soldier stationed in Europe, with Patton's Third Army. "I figured after being in the Battle of the Bulge with all that freezing snow, I didn't want any more winters so I came out here," he says. Bell remembers when the runway at Flabob was half blacktop and half dirt. "Even on the

Rick Wallace showed up in a cute-as-a-button hot-air dirigible during the Vintage Aircraft Association Chapter 33 fly-in last May. flightline between the hangars there'd be a big patch of bare dirt, and, of course, you'd run up [the engine] and turn and dust would be flying everywhere," he says. "You'd get chewed out when somebody was painting."

Another frequent Flabob presence is pilot Andy Anderson, whose license plate reads "Flabob." Anderson retired in 1979 from the Santa Fe Railroad, where he'd spent most of his career as a telegrapher. Having learned to fly at the age of 53, he now spends most days flying his 1962 Cessna 150, and on a hazy afternoon last June, he let me ride along. When smog rolls in from the Los Angeles basin, Anderson, like other Flabob pilots, has his own landmarks for finding his way into the pattern: an ARCO gas station, a freeway intersection, and a shopping mall.

Returning on the downwind leg, we're flying directly at the most prominent landmark of all, Mount Rubidoux, a 1,400-foot-high rocky ridge only a half-mile off the end of the runway. Anderson takes dead aim at a 45-foot cross that stands on the summit. On a clear day, pilots say, if you line up the cross with some storage tanks on another ridge about three miles distant, you are exactly at pattern altitude and heading. Madariaga, Anderson reports, used to say that you fly until the cross fills your windshield, then you say a prayer and turn

Stats

FLABOB AIRPORT

Dining: Try the Flabob Airport Café, open seven days a week from 7 a.m. to 3 p.m.

Don't Miss: The **Experimental Aircraft Association Chapter** One's monthly barbecues; all fly-ins, drive-ins, and walk-ins welcome. Talk shop with such legendary Chapter One members as Ray Stits and Clayton Stephens. For calendar of events, visit www.eaach1.org and www.flabob.org, or write to EAA Chapter One, P.O. Box 3667, Riverside, CA 92519; phone (909) 682-6236. Annual membership is \$12.



left. Indeed, as Anderson turns onto base leg to come around and land, he seems to be uncomfortably close to the mountain. But he lands without event.

In the afternoon of September 3, 1984, Madariaga, 72, took off from Flabob's runway, something he had done thousands of times before. He and wife Bert were flying their twin-engine Piper PA-23-235 to Las Vegas. The Piper ascended at a steep nose-up angle and stalled; it then descended out of control and crashed, killing Madariaga and his wife. A National Transportation Safety Board investigation concluded that during his preflight inspection, Madariaga had not observed that the elevator was in the locked position, and thus he had taken off with no pitch control.

When son Don took over running the airport, heirs were divided on whether to keep it or sell it to developers. The uncertainty dragged on for 16 years, and dispirited the Flabob community.

Leo Doiron, who has been the airport

manager under both the Madariaga family and Tom Wathen, remembers that "we had a core of people here, but a lot started to drift away. It was pretty much decided that they were going to sell the airport, so don't put any money into any of these buildings because they're all going to be torn down for houses."

Things began to wear out. "When Flavio put in all this piping, it was old steam piping and not galvanized," says Doiron. "We'd have a geyser here and a geyser there. It was like patching up a submarine once you spring a leak. Thank God Tom Wathen came along and purchased it."

Wathen had long ago worked as a line boy at an airport in Vincennes, Indiana, where he washed airplanes, swept hangars, and pumped gas in exchange for flying time, and the experience probably had a lot to do with his resolve to preserve Flabob as an airport. (Wathen got his private pilot's license in 1958. Today, he has more than 3,500 hours and owns several airplanes. He also rebuilds aircraft and has restored a number of vintage Ercoupe monoplanes.) But getting the airport

Ripcord, a Labrador retriever, takes up his station at Jack Findley's hangar, which houses a Cessna 172 and other collectibles.



was a close call. Wathen was vacationing in Paris when his friend and attorney John Lyon, the secretary of the Wathen Foundation, called to say that Flabob was about to be sold to developers. After Wathen okayed the purchase, Wathen's son, Doug, and Lyon drove from Los Angeles that evening to meet with Don Madariaga at Flabob. Sorry, you're too late, he said. Madariaga was scheduled to meet with real estate developers the next morning to close the sale of the airport to them, but he did not yet have a ratified contract. Lyon offered the same amount as the developers: \$3,030,000. He then wrote a check for a down payment of \$100,000.

"We called Tom back in Paris and woke him up about three in the morning," says Lyon, "and I said, 'There's good news and bad news. The good news is we own an airport. The bad news is we just wrote a rubber check for \$100,000.' "Later that morning Wathen called his New York bank to cover the check.

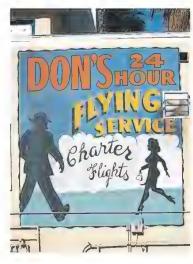
"We took over June 1, 2000," says Wathen. "You had to see this place four years ago. It [was] just one big dust bowl. I think we've removed 13 different structures from the property, and we've built 14 new ones. We paved the runway and all the taxiways up to the hangars."

"Tom Wathen is so much like my dad it's amazing," says Don Madariaga. "He's like a reincarnation—his love of aviation, love of Flabob, and love of people."

In addition to the new facilities, Flabob now boasts a big new EAA Chapter One hangar, which will house some of the new academic programs under way. To run Flabob's education programs, Wathen hired Art Peterson, a former university professor and college president. Peterson is also an aviation enthusiast. In 1969 Peterson had a job that required him to travel long distances, and he took up flying because he felt it was safer than driving. "I thought it was kind of nice of Tom to take an old codger in like me," says Peterson. "I was 72 when he hired me. But I love aviation and I love education, and this was just the perfect place to come."

Peterson and his assistant, Kathy Rohm, whose title is director of community relations, are the paid staff for the program. "We go out to grade schools in Riverside County and give rudimentary courses in aviation," says Peterson. And once a month they run five-day programs at Flabob for middle- and high-school students. "My entire







faculty is unpaid," he says. "We have 12 to 15 experienced people who come in and share. One woman is a top lighter-than-air pilot; she flies a Fuji blimp."

"I love the progress we've made," says Wathen. "I wish we'd done it all in the first year, but now we've got momentum. It has been so exciting for me to think of what we can do here, and it becomes more and more possible all the time. What I see now is a building of the infrastructure to form classrooms and ultimately housing for the youngsters, and a more active recruiting of youngsters. I see the airport as EAA West."

There are still ties to an earlier era. The end wall of the café is covered by a large mural advertising the bygone Don's Flying Service. Now and then somebody touches up the paint.

And the art of scrounging hasn't been lost. One of the first sights to greet people driving in to park at the café is a 12-foot replica of the Wright *Flyer*, mounted on a steel pylon. The propellers turn slowly, powered by chains that are driven by an electric motor. In a move that would have pleased Flavio Madariaga, the replica was rescued from a float that rode in last year's Pasadena Rose Parade.

A 1941 Aeronca that had been abandoned at Flabob is being restored by a group of high school students (top).

Flabob's past mingles with the present: Don's Flying Service was based there during the airport's heyday in the late 1940s.

Nick Baker's de Havilland Tiger Moth is available for rides during Flabob's twiceyearly open houses.

Explorers Wanted | Sean O'Keefe

It's 2025. Do you know where your children are?

Two decades and 240,000 miles from here, NASA engineer Jake Crosby hops out of his bunk to begin a new day at Lunar Base Discovery One. Crosby's job—hunting for useful minerals on the moon—has led him to an important but unexpected discovery. With the help of robotic rovers and advanced sensors, he has located ancient lunar ice within the South Pole Aitken Basin. The ice was deposited by comets that struck the moon millions of years ago and, once extracted, could yield enough water for the base for six months.

Crosby has the feeling there may be more ice out there, which could ultimately be split into hydrogen and oxygen. He bounds down the corridor of the residence module, his progress propelled by the moon's low gravity, by his sense that he's on the adventure of his life, and by the unmistakable aroma of pancakes.

Another 690,000 miles from Earth, Suzanne Powell, an astronaut-astronomer, is monitoring the deployment of a paper-thin space telescope one acre square—a test to see if very large telescopes capable of taking pictures of planets in other solar systems can be built in space. She floats near her spaceship, watching the foil unfold like a metallic butterfly emerging from a cocoon. Astronomers have already found nearby stars with Earthsize planets, some of which harbor chemical signatures of life in their atmospheres. Powell wonders what shapes the landmasses on these planets take. Are they similar to Earth's? Will people ever be able to travel to them? A beep interrupts her thoughts and draws her attention to a jammed spar on the unfolding telescope. Back to work...

On Earth, Jason Hernandez scans data from the Argo craft, which entered orbit around Jupiter's moon Europa a week ago. As one of the mission's controllers, he is awaiting the first mapping data from sensors that can measure depths beneath ice. Twenty years ago, another NASA spacecraft found evidence of the oceans later confirmed on Europa and two sister moons. Ocean-depth data will be the basis for missions to explore Europa's ocean with submarines.

Like many of his colleagues, however, Hernandez is excited about the Argo for another reason: It is the first robotic spacecraft with enough power to move completely on its own among Jupiter's moons. Argo's propulsion

Each mission serves as a building block for the next. Each discovery will fuel the spirit to press on.

technology will finally make it possible to send humans to Mars. The mission has been scheduled to launch in 2035. Then 30 years of robotic science missions preparing the way for the astronauts will have paid off, and four lucky space travelers will walk on Mars.

This may seem like science fiction, but it is the central focus of President George W. Bush's vision for the U.S. space program. To realize his vision, NASA is planning an interconnected sequence of robotic and crewed missions over the next few decades to achieve two momentous goals: one, to extend a sustained human and robotic presence across the solar system, and two, to search for habitable envi-

ronments and life on other worlds.

Yes, it's official. Exploration is now a career opportunity.

Getting to these worlds will be one of the biggest challenges humankind has ever embraced. But we can do it. The United States has an unmatched, 45-year track record in space exploration. And in one important sense, we will reach our objectives in space in the same manner in which two of our nation's most remarkable pioneers, Lewis and Clark, did on their storied trek through the uncharted American Northwest: one step at a time.

The key feature to NASA's plan is a stepping-stone approach, which will allow us to make sustainable, affordable progress. Each mission serves as a building block for the next. Each discovery will fuel the spirit to press on. We will go boldly, but logically.

One step we'll take before this decade is out is the development of a space-craft to replace the space shuttle. The Crew Exploration Vehicle will be capable of carrying astronauts farther, faster, and more safely. It will require new systems of propulsion, life support, and radiation shielding. The vehicle will be modular; we'll be able to upgrade it gradually. It will be the basic platform upon which we will steadily advance the technology of space travel, with the eventual goal of getting from Earth to Mars in a fraction of the time that it would take today.

But before that, we will use the Crew Exploration Vehicle to launch a new generation of telescopes into deep space, service the International Space Station and other space platforms, and support lunar missions.

On the moon, we'll learn what it takes to sustain and protect human life on other worlds during longer and longer missions. We will learn how to mitigate the effects of radiation, isolation, confinement, reduced gravity, and conditions that will become known to us



only after we begin to live in the new environment.

We'll also learn how to use raw materials that we find on remote worlds, so that we can reduce the tonnage of what we need to lift into orbit. For example, we will experiment with converting the ice that may reside in the dark lunar craters into oxygen to breathe, as well as hydrogen to power engines and generators. The moon will be an ideal proving ground and test bed for the people and the technologies bound for other worlds.

Near the moon is an area of space where it is possible to place telescopes many times larger than any we've ever put into space before. Situated where no distorting atmosphere can cloud their vision, these super telescopes can search out Earth-like planets or moons around distant stars, see farther into the outer reaches of the universe, and bring us ever closer to finding answers

to some of the biggest questions we face: where the solar system came from, how the universe is evolving, and whether we are alone.

Simultaneously, robotic explorations, including some to bodies as remote as the moons of Jupiter, the asteroids, even Pluto, will have contributed to our knowledge and to our readiness for the next big step: sending people to Mars.

Mars is hundreds of times farther away than we have ever gone. But in 1961, so was the moon. A little more than 40 years ago, mankind had traveled no farther than 135 miles from the Earth's surface. And yet we believed that the moon, a quarter-million miles away, hundreds of times farther than we'd ever ventured into space, was within reach. By taking a disciplined, sustainable, affordable approach, we will bring Mars within reach.

One essential step will be the development of propulsion systems that are many times more powerful and efficient than those that propel our robotic missions today. Right now, a number of propulsion designs are on the drawing board, or being tested, that could conceivably cut almost in half the time it would now take to travel to Mars, making the trip much safer for the crew.

There will be those who argue that humans need a better reason to go to the moon, and to Mars, than just being able to get there. But as anyone who has followed our space program knows, there are a lot of reasons to go into space.

The effects of space travel on human beings—all six billion of us—are really quite amazing. Our ventures in space have yielded breakthroughs in medicine, communications, computers, and countless other technologies that help make life better, and even possible, for people all over the world.

Space-related ventures also provide careers for millions of people everywhere, and give some of the planet's best minds the environment and the tools they need to help solve some of our toughest challenges. The next decades in space exploration will yield even greater advances in the critical areas of nanotechnology, biotechnology, robotics, computer networking, and energy. Our next big stride into space will give a boost to all of these technologies, plus one thing more: It will give humanity permission to dream big. And it will sound a clear, compelling call to the next generation, our children's generation, to envision and prepare for a future of great deeds journeying across the solar system and great discoveries—finding life beyond Earth. That future will be designed and built by a new generation of scientists, mathematicians, engineers, and a whole array of experts in technologies that don't yet exist.

As we get ready for the next leg of humanity's journey, consider our progress so far: In 1903, people learned to fly. In 1969, we stood on the moon. Today, thanks to the NASA rovers *Spirit* and *Opportunity*, we look out on Mars. It's no big stretch of the imagination to see that humanity's fortune isn't limited to one small quadrant of Earth's immediate neighborhood but rather could and should be forever advancing across our solar system and beyond.

Sean O'Keefe is the Administrator of the National Aeronautics and Space Administration.



TALES FROM THE ERA WHEN THE AIR AGE MET THE STONE AGE.

BY TONY REICHHARDT

We earth-bound geographers are inclined to look with a jealous eye upon these fine gentlemen of the air. For they soar up aloft and glide gracefully over the most terrible obstacles.... And we geographers are glad enough to shake hands with them, because we realize what great use aviation may be to geography.

When Sir Francis Younghusband, the president of Britain's Royal Geographical Society, made those wistful remarks at a society meeting in February 1920, explorers had only recently begun using airplanes to visit the few regions of the globe still uncharted by Westerners. But the conditions were right for a new

In one of the first expeditions to use airplanes, a Curtiss Seagull (above) enabled A. Hamilton Rice to map Amazonian rivers. Opposite: Natives approach a Fairchild monoplane used on a 1929 expedition to New Guinea.

era of increasingly ambitious aerial expeditions.

For one thing, World War I had trained a generation of pilots, some of whom then turned to exploration. Richard Byrd, who would travel to the North Pole in a Fokker VII Trimotor, started his career as a pilot for the U.S. Navy. The war also spurred the production of aircraft, and after the Armistice, surplus military airplanes were plentiful. So were powerful Liberty engines, which could push explorers higher and farther than they had journeyed before. And wartime demands increased the sophistication of aircraft designs. The Germans and French, for example, developed airplanes with metal skins, which could hold up better than wood in the harsh, wet environments explorers hoped to conquer.

With the benefit of all these advances, explorers could at last penetrate the remaining holdouts from the Stanley and Livingstone era of exploration: the North and South Poles, Borneo, a few isolated areas of southern Africa, and the mysterious highlands of New Guinea.

One of the first explorers to incorporate aviation into his expeditions was Harvard geographer and physician Alexander Hamilton Rice. A gentleman explorer whose upper class accent was perfectly suited to the lecture hall, Rice was married to Eleanor Elkins Widener, a Philadelphia heiress and *Titanic* survivor. The couple's house in Newport looked like Versailles, only nicer.

Rice was determined to find the



source of the Amazon's Orinoco River, thought to be somewhere in Brazil or Guiana. He had already tried to penetrate the Amazon rainforest the old-fashioned way. In 1920, on his sixth trip to the region, Rice had been turned back by natives wielding arrows—probably Yanomamo, descendants of tribesmen who had fought off Spanish soldiers two centuries earlier. For his seventh trip,

he acquired two new inventions: Thompson submachine guns and an airplane.

The aircraft, a pontoon-equipped Curtiss C-6 Seagull named the *Eleanor III*, had only three seats; two would go to the crew, and one would be used to hold a bulky Fairchild camera. Rice hired two famously daring airmen: Walter Hinton, a 35-year-old Navy pilot, had made the first aerial

crossing of the Atlantic five years earlier, in a Curtiss NC flying boat, and Captain Albert Stevens of the U.S. Air Service had accompanied Army pilots Oakley Kelly and John Macready as the photographer on the first nonstop flight across the United States. For Rice's expedition, Stevens would again serve as aerial cameraman.

On the ground, Rice and his party of 100—including Indian porters and paddlers, a physician, a cartographer, an ethnologist, and a motion picture camera operator—would travel by steamboat. In July 1924, they set off from the north Brazilian city of Manaos. When the team got to the narrower stretches of the Negro, Branco, and Parima rivers, which lead to the headwaters of the Orinoco, they switched to canoes.

Meanwhile, every day Hinton and Stevens would hop in the floatplane—typically in the cool of morning, when photography was best and they could pick out small streams by the wisps of rising vapor—and head upriver. As Hinton flew at about 6,000 feet above the jungle, Stevens would photograph the scenery below and sketch maps. While the canoes below needed two weeks to navigate a 40-mile stretch of rapids, the *Eleanor III* crew could cover the same ground in a half-hour flight.

But it wasn't all easy. Early on, to save weight and air resistance, the fliers removed the windshield; flying at 70 mph, impacts with raindrops could be painful. And flying over dense, unbroken jungle in an aircraft fitted only for water landings was a potentially scary prospect; it was vital to keep a sharp eye on the thin ribbon of river below.

One day Hinton made a rare flight without Stevens, treating another member of the party to a bit of sight-seeing. When the Curtiss started to lose fuel pressure, the guest was instructed to break out a hand pump carried for such occasions; he ended up having to work it furiously for an hour and a half while nervously eyeing the treetops below.

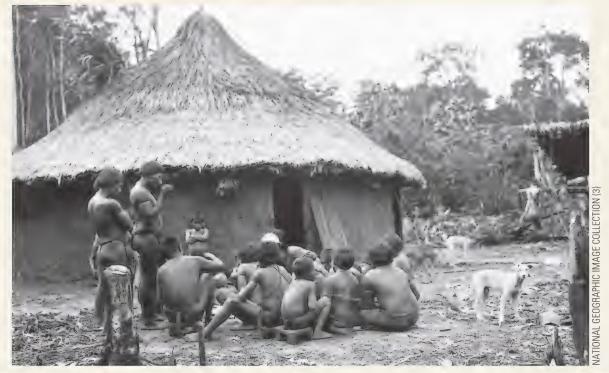
Another time Hinton and Stevens were mapping the upper reaches of the Parima River, a place no outside explorer had ever reported visiting.

Right: A Seagull's-eye view of the Parima River reveals a clearing for an Amazonian camp, which housed about 30 people. Bottom: A ground shot of the same camp; pilot Walter Hinton's helmet can be seen in the center of the group. Hinton gave the Indians clothes and knives in exchange for bows and arrows and blowguns.





The Rice expedition:
Photographer Albert
Stevens is at left,
Hinton is behind the
crouching man, and
Rice is second from
right. The team also
had a navigator,
mechanic, interpreter,
telegraph operator,
physician, and movie
cameraman.



Often when they spied native settlements in clearings, they would descend to take pictures and drop parachutes with peace offerings beads and trinkets meant to brighten the natives' attitude toward other members of the party who would soon arrive on the ground. When they started to drop in this time, the rapid descent into the hot air of the valley caused the water in their radiator to start boiling over. Unable to climb, Hinton was forced to execute a series of nerve-racking banks within the steep walls of the river canyon before finding water smooth enough for a landing.

In the corrosive environment of the rainforest, the ability to do onthe-spot repairs was critical. The fabric wings and control surfaces of the Seagull had been coated with aluminum dope, which protected against the fierce equatorial sun. But the mahogany hull fared worse. The Eleanor III was in the water so much that its tail section started to soften; a month into the journey, it came loose during takeoff. Replacing the section took Hinton and Stevens two days, working on a muddy bank, in the rain, surrounded by clouds of gnats and mosquitoes.

As soon as the floatplane touched land, hundreds of ants were likely to stream aboard (they ate shoes and one of Hinton's shirts). Insects weren't the only pests. Sometimes Hinton had to throttle back and dive to avoid hitting large buzzards. Brightly colored macaws posed a similar threat, and they were easily spooked by engine noise. And each morning, "there was almost sure to be a spider" lodged within the airspeed meter, Rice later wrote.

Despite using mosquito nets and taking daily doses of quinine, Hinton and several other members of the expedition contracted yellow fever. Yet the pilot pressed on for nine months. Rice never did find the source of the Orinoco River—that would remain for another aerial expedition to discover in 1944. But he did find the source of the Parima River, and he and Stevens produced the best maps to date of that region of the Amazon.



The Amazon natives learned that the Seagull was nothing to fear. (Two of the children appear bothered by jungle insects called piums.)

mong anthropologists who would have watched news accounts of Rice's travels with keen interest, even a touch of envy, was Matthew Stirling. In 1924 he was 28 years old and had just quit his job as assistant curator for the Smithsonian's division of ethnology in Washington, D.C. He moved to Florida, which was then an incubator for the nation's first commercial airlines. Perhaps the change in location was responsible for Stirling becoming interested in aviation—to the point of trying what he later called "some abortive piloting." Together with two friends, Richard Peck, an aviation enthusiast and pilot, and Stanley Hedberg, a newspaper editor who could handle publicity, he began hatching a plan for the three of them to take an airplane to one of the most exotic places on Earth.

At the time, the interior of New Guinea was one of imperial Europe's last unconquered territories, a land said to be populated by cannibals, headhunters, and pigmies. New Guinea had a topography that was beyond hostile: an interior with sharp, snow-covered peaks and roaring rivers, and coasts covered with malarial swamps and thick jungle. The Spanish had ar-

rived there in the 16th century; by the 20th century, the Dutch, Germans, and British had carved New Guinea into three pieces. For the most part, though, they kept to the coastal low-lands. European maps in the early 1920s showed the interior highlands to be uninhabited, but in fact, the knife-like mountain ranges hid flat, fertile valleys that were home to hundreds of thousands of people.

It wasn't for lack of curiosity that the Europeans had never made it to the highlands. Between 1907 and 1922, Dutch, British, and German explorers had run a spirited "race to the snows," trying to scale 15,000-foot peaks like Mount Carstenz (now Jaya) and Wilhelmina (Trikora). Several of the expeditions had even made limited contact with the highland tribes. But the going was painfully difficult. Dozens of porters were necessary to keep up a supply line for a mere handful of explorers, and even then the progress could be agonizingly slow. During a 1926 expedition to locate the source of the Fly and Sepik rivers, a group of Australians had struggled for 10 1/2 hours to advance 300 yards through the rough terrain.

The southeastern third of the island, containing the territory of Papua,

was therefore a natural target for airborne exploration. The first aerial expedition to the area was led by Australian adventure photographer Frank Hurley, who arrived with a team in two Curtiss Seagulls in 1922. Hurley had traveled with Ernest Shackleton to the South Pole six years earlier, and had spent months trapped on a frigid Antarctic island, living under an upturned boat. "It was under that boat that the idea of exploring New Guinea was born," he wrote later. "In the daytime we talked of nothing but the tropics and palm trees."

When he got to New Guinea, Hurley had confined his aerial explorations to the settled areas near the south Papuan coast. Matthew Stirling's aims were far more ambitious. He wanted to venture into the mountainous wilderness of Dutch New Guinea, in search of the mysterious Nogullo pigmy tribe, which he had read about in accounts from a 1910 British ornithological expedition.

Stirling enlisted the Smithsonian as sponsor and the Dutch government as a partner. To make it past the perilous rapids that had blocked previous attempts to penetrate the interior, he was counting on two modes of transport. Seventy Dayak tribesmen from central Borneo, terrifically skilled canoeists, would negotiate the treacherous stretches of river in 10 boats. And a modified World War I-era Breguet14 B2 bomber would ferry supplies upriver and scout the route.

The Breguet was one of the first aircraft with a corrugated-metal skin, developed to get around the weakness and weightiness of wood skins. Stirling bought his from the Yackey Airplane Co., which had added pontoons so the craft could make water landings, replaced the original engine with a more powerful 400-horsepower Liberty, and added a few accessories to the cockpit, including a collapsible two-person boat, a camera mount, and a small "frigid air plant" to keep the film chilled. The airplane was christened the Ern, a popular crossword term for a sea eagle. Two Yackey employees, pilot Hans Hoyte and mechanic Albert (Prince) Hamer, joined the crew, and Richard Peck became the expedition's backup pilot and photographer.

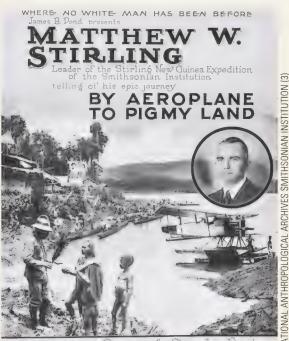
Stirling exuded confidence as he set sail from Batavia (now Jakarta), Indonesia, toward New Guinea on April 7, 1926, the Ern tied to the deck of the steamship Fomalhout. Speaking to the press while a regimental band played what one report described as "American airs," Stirling said, "I have the utmost confidence in our plane's motor to fly and keep flying over the jungles and mountains.'

Which it did, admirably. In two months of ferrying supplies upriver two or three round trips every day, typically with 700 pounds of cargo on each trip—the engine never failed once. But there were plenty of nervous moments. Stirling's notebook from the expedition—written in a neat, flowing hand that fills nearly every inch of every page—is in the Smithsonian's National Anthropological Archives in Suitland, Maryland, looking amazingly fresh, considering all it must have gone through 77 years ago. The daily entries include this description of a harrowing May 15 encounter with natives, which took place as Stirling and Hoyte returned to the airplane after leaving a cache of supplies far up the Rouffaer River:

The air was fairly ringing now with shouts and cries, and five or six canoes with about 25 men were paddling out into the river about 400 yards above us, armed with bows and arrows and gesticulating wildly. In a couple of minutes we saw an



At the start of Matthew Stirling's New Guinea expedition, his Brequet was loaded on a ship in Java. When he returned, he lectured on his travels among the Nogullo pigmies.



equal number of canoes on the river below paddling vigorously upstream toward us.

There being only two of us, we decided that it was high time to evacuate. At this crucial juncture, we saw that the radiator was leaking, so I filled a five-gallon kerosene tin with water while Hans climbed up on the engine and poured it into the radiator. We did not dare put in more as the canoes were slowly working nearer to us.... After closing the radiator cap, Hans started priming the engine and in his haste burned his arm on the exhaust pipe. We then let loose our line and threw it with the anchor into the cockpit.

Now the problem of taking off! With the line off, I had to hold the wing of the plane inshore, while Hans got on the wing to crank the engine. As the Liberty was still hot from her long pull, this was no simple task, and as is usual when in the biggest hurry, the engine refused to start. It is heavy work and Hans, already tired, was soon almost exhausted...

In the meantime the Papuans above began shooting arrows at us, some of which bounced off the aluminum side of The Ern. I fired my 45 into the air, and the Papuans dove into the water from their canoes and the arrows stopped coming. On reflection, I think they were shooting at the plane rather than us.

It was probably about five minutes, though it seemed an hour, when the engine caught. The welcome roar of the Liberty at that moment was one of the sweetest sounds I ever heard in my life. I swung the nose of the pontoon into the stream as Hans gunned the engine and made a dive for the end of the wing as the plane headed into the stream, her tail barely clearing the tree below us....

Stirling's expedition was marred by violence: 16 members of his party and an unreported number of tribal people were killed during encounters before the American and Dutch explorers finally reached the highland pigmies, who were friendlier. As for the *Ern*, it lasted only as long as the glue on the pontoons held out. When



Sterling's Breguet came with conventional landing gear; he later replaced it with pontoons. "We were somewhat anxious about the results," he recounted.

that dissolved, the airplane was abandoned on a river bank. Peck removed the propeller and engine (which, according to Stirling's diary, he "pickled" in Vaseline) and shipped them back to the States, along with some 8,000 artifacts from the New Guinea wilderness.

Hoyte, his flying duty over, left for home, but got typhoid fever on the way and died in Egypt.

Peck evidently didn't get his fill of adventure, for he returned to New Guinea three years later as chief pilot for another expedition, this one led by E.W. Brandes, a plant pathologist with the U.S. Department of Agriculture. The goal was to search the territory of Papua for disease-resistant strains of sugar cane that could be transplanted in the States to help shore up the flagging U.S. sugar industry.

This time, Peck's ride was a marked step up—a Fairchild Cabin Monoplane, the same model Richard Byrd took to Antarctica in 1929. Designed for aerial photography, the Fairchild had a heated cabin instead of an open cockpit, wings that folded for easy storage, and a longer range and higher service ceiling than the Breguet's.

By the summer of 1929, air transportation was more than just a way to supply a canoe party. It had become the prime means of exploration.

Setting out from base camps on the Fly and Strickland rivers and landing on whatever stretches of smooth water were handy, Peck logged some 10,000 miles in 57 fights. Along with the usual challenges of jungle maintenance and repair, he had to add mountain flying to his repertoire. On one occasion, crossing the central mountains, he found himself flying blind in a misty rain at 14,000 feet. "I saw Peck look anxiously at the thermometer on a wing strut," Brandes later recalled. "It registered 33 degrees Fahrenheit." Peck wanted to lose altitude to prevent ice forming on the wing, but couldn't with the mountain peaks near, so he had to hang on until the coastal lowlands came in sight.

Encounters with the natives were less violent than they'd been on Stirling's expedition, but Brandes' behavior did nothing to ensure smooth relations; he was rude at best, racist at worst. His idea of an amusing sport was buzzing a canoe full of natives so they jumped overboard in panic. In his narration of film footage shot during the expedition, the scientist open-



During Richard Archbold's 1938 trip to New Guinea, workers formed a relay line to unload cargo from the Guba, a Consolidated PBY model 28 flying boat.

ly expressed contempt for the people he encountered: "Their faces reflect only primitive bestial passions," and they had "an odor strikingly reminiscent of a zoo." Never mind that the New Guinea highlanders were a linguistically diverse culture, that they were one of the few populations in human history to independently invent agriculture, and that they thought the white men stunk too.

What did these "lost" tribes think of the visitors and their flying machines? In the inevitable *National Geographic* article written after his trip, Brandes claimed: "I alighted from a plane before a cannibal camp in the remote jungles of New Guinea and was mistaken for a god!" No question, some natives were terrified just by the sight of white people, let alone white people dropping from the sky. When Australian gold prospector Mick Leahy and his brothers walked into the highlands of east-central New

Guinea in 1930, the natives thought they were dead ancestors come back to life. And in the fascinating 1983 film *First Contact*, by Australian documentary makers Bob Connolly and Robin Anderson, some of the older New Guinea natives, recalling their reactions 50 years later, said that when they first saw and heard an airplane, they became so frightened they wet themselves.

Others, though, were relatively unfazed. The Amazonians who had met

Hamilton Rice called his Seagull "the great insect," and when it took off noisily, they retreated to the forest. But airman Albert Stevens noted that they appeared to be far more impressed by flash photography than by airplanes.

The explorers on Stirling's voyage

Perhaps it was pride that inspired the entire staff of the expedition to pose on the Guba's beefy wings.



seemed most pleased when the natives showed fear in ways that struck them as comical. After one landing, Stirling, using gestures, asked villagers on the Mamberamo River what they had thought when they'd seen his airplane overhead. He recorded the response in his journal: "Holding their arms extended horizontally, they ran up and down in front of camp, with the most excruciating facial grimaces imitating the sound of the motor. This accomplished, they threw themselves flat on their bellys [sic] and burrowed their faces in the mud, presumably by way of illustrating their own actions at the time."

Down the hall from Stirling's notebook, in the Smithsonian's Human Studies Film Archive, researcher Amy Staples offers her own narration to the flickering black-and-white footage shot during the 1929 Brandes expedition. On the television screen, Papuans from the Lake Murray area stand in a long, snaking line, bringing shrunken heads, ornamental feathers, and other prized possessions to trade with the visitors from the sky.

In their post-expedition writings and lectures, the explorers often focused on exotic symbols of native mythology, but, says Staples, the Western aerial explorers had mythology of their own. "There was a whole fascination in America with flight," she explains. "The airplane allowed the audience a new sense of discovery, and contributed to this mythology of 'first contact'—a fascination





Richard Peck works on his Fairchild's engine during a 1929 New Guinea trip.

with the contrast between modern civilization and 'primitives,' " bordering on obsession.

And the airplane shared top billing. When he hit the lecture circuit after returning to America, Stirling wowed his audiences with tales of journeying "By Aeroplane to Pigmy Land."

"unknown" places were becoming fewer and farther between. The poles had been conquered, the Yukon surveyed, and Everest photographed from above. Even in the highlands of New Guinea, Mick Leahy and company had natives busily stamping meadows into airfields so that Junkers transports could supply the gold mines in the interior, making New Guinea's airports among the busiest in the world in the 1930s in total cargo weight delivered.

One by one, the last isolated valleys of the interior were entered and mapped. Finally, in 1938, Richard Archbold, yet another wealthy explorer, flew the mother of all expeditionary airplanes into the New Guinea highlands. It was Archbold's third trip to the country, under the sponsorship of the American Museum of Natural History in New York, and this time the head of the expedition did the flying himself. The *Guba* (Papuan for "wind"), his twin-

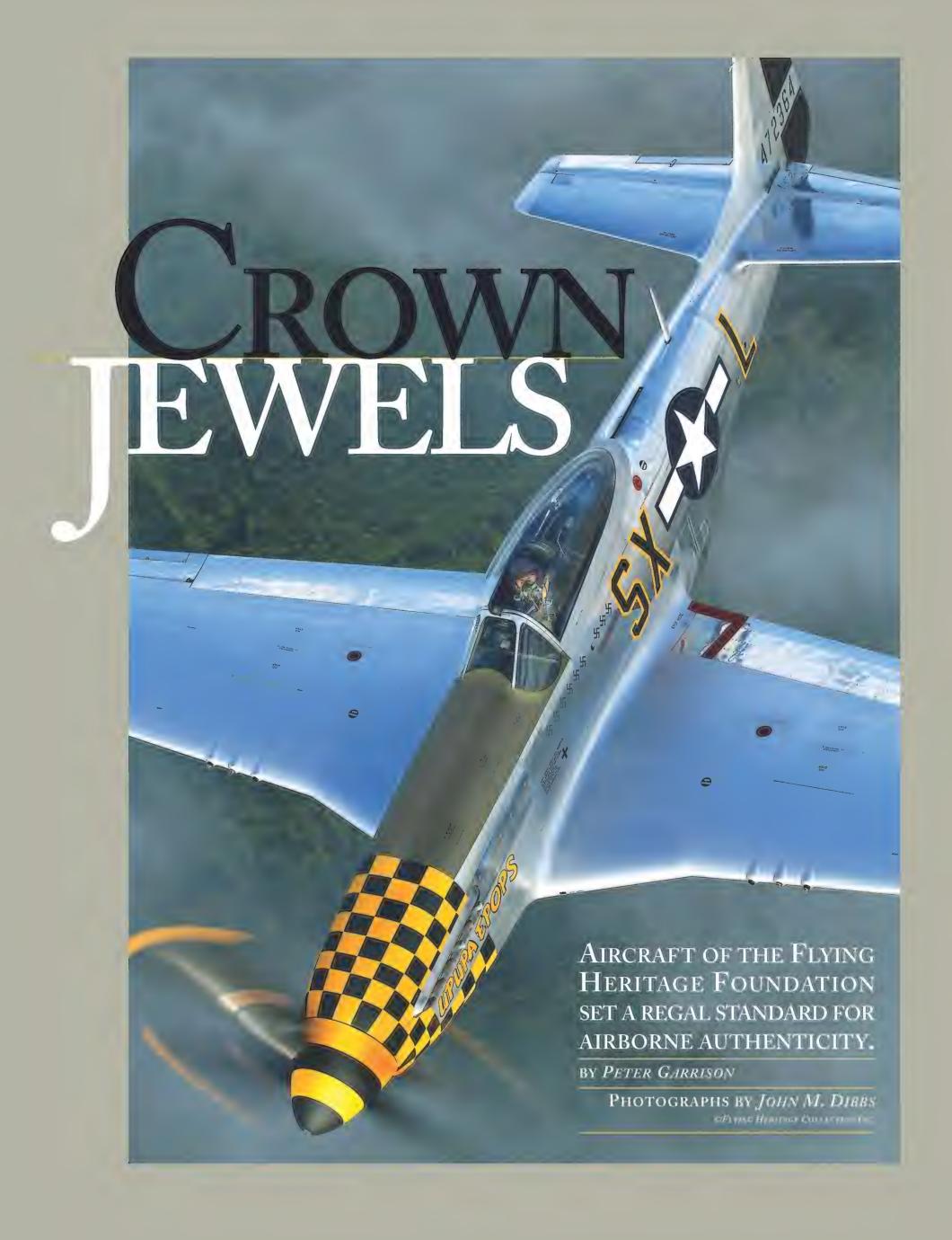
engine Consolidated PBY model 28 flying boat, was at that time the largest privately owned aircraft in the world. With a cruising range of 500 miles and a cargo capacity of three tons at sea level, the *Guba* handled all the transport for a party of 195 people.

Archbold's biggest trophy was his "discovery" of the Grand Valley of the Baliem, where 60,000 members of the Dani and other tribes were living in agricultural villages, their tidy fields plainly visible now that explorers could fly high enough to cross the snowy peaks of western New Guinea.

Scientist, author, and former New Guinea field worker Jared Diamond has called Archbold's expedition the "last first contact" between an exploration team and a large population isolated from the rest of the world. After World War II, missionaries and anthropologists started traveling in droves to the New Guinea highlands, and the allure of the unknown began to fade.

The "hidden" Baliem Valley is today a tourist attraction, and vacationers have a choice of hotels. One fly-and-hike adventure package offers a seven-day/six-night stay, with a level of difficulty described as "easy to moderate."

Easy? Matthew Stirling, Hans Hoyte, and the rest might find that a bit hard to believe.



t the end of January 1945, a P-51 Mustang, one of about 8,000 built by North American Aviation during World War II, rolled off the assembly line in Inglewood, California. At about the same

time, a young fighter pilot, Harrison B. "Bud" Tordoff, finished his first tour of duty in England and went home to the States on leave.

Tordoff had been a 19-year-old sophomore at Cornell University, studying ornithology, when he enlisted in the fall of 1942. "I had never been in a plane in my life," he recalls. "I was eager, thrilled with the poem 'High Flight,' and hoping to avoid fighting on the ground—completely naive." Having depth perception that "wasn't up to Air Force standards," he passed the vision test by observing the settings used on the testing apparatus by the candidate ahead of him. Nevertheless, during his first 69 missions he shot down three Bf 109 fighters, two of them on his very first encounter with the Luftwaffe.

When he returned to duty on March 1, 1945, he found the brand-new P-51D waiting for him.

Tordoff had christened his first airplane, a P-47, Anne after a girlfriend whom he'd met just before shipping out for his first tour. When he switched to the P-51, he had cooled on Anne and wanted a new name. It happened that in 1944 a B-17 called Murder Inc. had gone down in Germany, and Nazi propaganda had made hay out of the name. Thereafter, the Eighth Air Force required official approval of airplane names. "I thought I would bug them with an unfamiliar name," he says. He drew on his knowledge of ornithology: "I liked the scientific name of the hoopoe, Upupa epops, for its silliness, and the bird seemed appropriate, given its seeming weak flight, bizarre appearance, and untidy nesting habits." Some poor bureaucrat may have spent hours trying to tease a double entendre out of the Latin name, but it was approved without comment.

During the six weeks that remained before the war in Europe ended, Tordoff shot down two more German airplanes, one of the kills a lucky strike he got by hitting the engine of a fleeing Messerschmitt Me 262 at long range.

At the war's end, Tordoff and the -51 parted ways. He returned to Cornell in September of 1945 and, having taken courses while in the Army, graduated the following year. *Upupa epops* remained in Europe. Sold to Sweden in 1947, the Mustang served there until 1954, when it was purchased by the Dominican Republic.

In 1999, a shadowy consortium of airline pilots in the Pacific Northwest bought the P-51 from Florida warbird dealer Brian O'Farrell, who had acquired *Upupa epops* among a lot of retired Dominican Mustangs in 1984. The so-called consortium—really a front for an anonymous collector—delivered it to WestPac Restorations in Rialto, California, where it remained for two and a half years before being flown to Arlington, Washington, in livery exactly matching that in which it had left the North American factory in 1944.

There, on August 19, 2003, Bud Tordoff, after a distinguished career as an ornithologist—his specialty, appropriately, was falcons—met *Upupa epops* again.

Tordoff had come to Arlington at the invitation of Paul G. Allen, cofounder, with Bill Gates, of Microsoft. Allen was the mystery collector. Too many times a millionaire to be worth counting, he is also a philanthropist, and fond of creating public museums of things for which he has a passion. At the foot of Seattle's Space Needle, a Frank Gehry-designed building that resembles a pile of brightly colored laundry billowing in a high wind houses his interactive rock music museum, the Experience Music Project, as well as his Museum of Science Fiction. In addition to rock and roll and sci-fi, Allen had long been enamored of aviation and wanted to collect and exhibit examples from the 1940s and '50s heyday of fighter development, especially the advanced German aircraft of World War II. And he was prepared to spend some money to do it.

In 1998 Allen had engaged Jeff Thomas, an American Airlines 777 captain and aircraft collector, as a consultant. The sandy-haired, youthfullooking Thomas was the son of a Navy mechanic who had worked on Wildcats and Hellcats in the Pacific. Thomas had done some professional restoring himself, and owned Vintage Wings, a historic aircraft restoration business.

The two brainstormed their way to the idea of an airplane collection that would emphasize the "artifactual" value of its contents. The airplanes would be recognized both as the pinnacles of their technological eras and as stars in historical and—as it would turn out in a few cases—personal dramas. Allen and Thomas hoped to acquire fighters that had seen combat; the details of any engagements would be researched so that each aircraft could be displayed with a specific his-





In 1945, Bud Tordoff and his P-51D Upupa epops (above, left) fought the Germans. Last April the white-haired Tordoff joined collector Paul Allen (above, right) to watch the restored Mustang fly again (opposite).



The Cyrillic on the side of this Polikarpov U-2/PO-2 pledges "Revenge for Ducia"—a fallen comrade.

tory, not merely a summation of the type's dimensions and capabilities. Everything about each airplane—its service history, its air crews, the materials and methods of its manufacture, its armament and internal equipment—would be documented to the highest degree of historical scholarship. Restorations would be done to a standard of authenticity never before attempted.

And they would fly.

This was the crux of the project. In the past, collections of historic airplanes had gone one way or the other: Either the airplanes were highly authentic but statically displayed (such as in the National Air and Space Museum), or compromises in authenticity were made for safety and reliability of flight (as in the Commemorative Air Force's fleet).

Although airplane collecting—unlike, say, art collecting—has been going on for a relatively short time, by

the late 1990s most of the really good "pieces" were already in museums or private collections. The untouched, unappreciated biplane in a barn, the bomber at the bottom of a clear lake—these were largely of the past. Time was swiftly overtaking what undiscovered relics remained, especially those in the Pacific theater, where salt moisture devours aluminum airframes. On the other hand, some enthusiasts who had bought old warplanes with a dream of restoring them had become discouraged and wanted to sell.

Since a small market like that for historic aircraft could be severely distorted by the financial weight of a Paul Allen, Thomas worked in secrecy. Still, word spread through collection circles that a mysterious 800-pound gorilla was on the prowl for warbirds. Over the span of just five months, Allen and Thomas assembled the core of their collection, spiriting away some of World War II's most iconic airplanes—a Messerschmitt Bf 109E-3 and a Focke-Wulf Fw 190A-5, a Hawker Hurricane Mk.XIIB and a Supermarine Spitfire Mk.VC, a

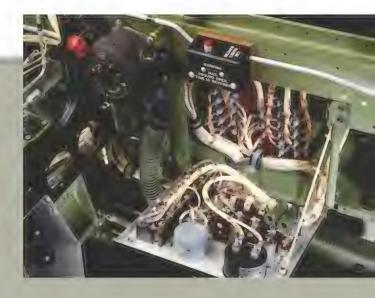
Lockheed P-38J Lightning, a Vought-designed, Goodyear-built FG-1D Corsair, a Mitsubishi A6M3-22 Zero-Sen, and *Upupa epops*—to a secret destination the warbird community dubbed "Area 51" (for the Air Force's secret Nevada test site, long part of the lore of the flying saucer crowd).

Because of the project's standards, prior restoration—which usually entailed making an airplane look superficially genuine to an untrained eye would not be a help, and in fact would usually be a hindrance. Owners concerned only with a period "look" would almost certainly have used improper paint, markings, and equipment. These would have to be stripped away until the airplane was scarcely different from an untouched hulk. "People would pull the old radios out of airplanes and just toss them into the trash bin," says Thomas. "They were no good for flying, and people wouldn't see them in a static display." In the Flying Heritage Collection's airplanes, the original tube radios would work. Luckily, most of the airplanes in the initial collection were complete and had not been restored, or, if restoration had been started, it was of an acceptable quality. Only in the case of the Fw 190 was it necessary to undo what had been done.

Inevitably, the values on which the collection was founded would conflict. Perfect authenticity could be at odds with safety of flight, especially in the oldest designs and in airplanes, like a Messerschmitt Me 262A-1a, that had originally relied on then-immature tech-

Fabric-covered wiring in a P-51 cockpit panel is one of WestPac Restorations' efforts at authenticity.

PRIOR RESTORATION—WHICH USUALLY
EYE— IN FACT, B1





nologies. Some historically correct materials, such as the lacquer-coated cotton insulation on wiring, would wear and age more rapidly than modern ones. And there would be the subtler challenge of balancing historical authenticity against perfect restoration—what Javier Arango, a California collector of World War I aircraft, calls "Plato's temptation," whereby "the artifact created is presented in its ideal state rather than its utilitarian one" by a craftsman whose instinct is to produce perfect work rather than to duplicate the routine output of a wartime factory. Warplanes were, in fact, manufactured rapidly, in the expectation that their service lives would be short. Once deployed, they were soon dingy, dented, patched, and oil-stained.

Thomas and Allen believed it essential to reproduce the original builders' process. If you used the same processes, authenticity—blemishes and all—would follow naturally. "Take the time to be imperfect," Thomas would say to prospective restorers, some of whom found his demand for minute fidelity to ancient and obscure standards and procedures to be incomprehensible, impractical, or simply beyond their capabilities. He would not compromise. "To have honest pieces, we had to consider the methods by which they were made," he says.

Thomas identified several restoration shops that could handle the work, and gathered them for discussions about the collection's philosophy. He encountered resistance from some who had always worked in secrecy and did not care to share their methods with competitors. Other shops could not or would not adjust to the collection's stringent requirements. Eventually, all but four fell aside, and JME Aviation in England, Southern California's Aero Trader and WestPac Restorations, and Thomas' own Vintage Wings got the work (though other shops may be hired as restorations continue).

After nearly six years, in April 2004, the nature of the collection and the identity of the project's backer were made public. "It took a great amount of time and effort to sharpen the focus and the end result," Thomas says. "But we have it now, and want to share the steps from the beginning of the restoration process to the eventual flight of the aircraft." The collection now publicizes its activities with a Web site (www.flyingheritage.com) and invites the public to its base, on a former World War II training field in rural Arlington, a small, forest-encircled town an hour north of Seattle. There, staff of the nascent collection, still housed in temporary quarters, give guided tours (\$20 per person, by reservation only) and occasional flying demonstrations.

At present, only about a fifth of the Flying Heritage Collection can be seen, and of those airplanes, only a Curtiss Jenny biplane primary trainer, two German vengeance weapons—one a Fieseler Fi 103 missile, better known as a V-1 "buzz bomb," and the other a Fieseler Fi 103R Reichenburg manned missile, which was equipped with a tiny cockpit from which the pilot was to jump after pointing the cruise missile at its



Jeff Thomas (above, left) and Vintage Wings' Mike McGuire discuss the collection's Spitfire. JME Aviation owner Jeremy Moore (opposite) fits a flap hinge bracket in the Fw 190.

target—and *Upupa epops* have been restored to the collection's standards. ("I was very impressed," says Bud Tordoff of *Upupa epops*' restoration. "It was more elegant than I remembered it. Fresh paint, and cleaner. It was as close to 1945 standards as you could get it. They even offered to let me start it up and taxi it, but I declined.") The others, which look good but are either incomplete or still historically incorrect, include a Curtiss P-40C Tomahawk, casually restored by a previous owner and currently painted with the expected, but in this case incorrect, shark's mouth; the time-tortured shell of a Mitsubishi A6M5-52 Zero-sen not destined for restoration (displayed to illustrate the fate of unrescued warbirds); and a Polikarpov U-2/PO-2, the rickety biplane flown by the famous Russian women's ground attack squadron that the Germans called "Night Witches."

In one workshop behind the scenes, a Vietnam-era Republic F-105 Thunderchief—a gigantic thing, more like a locomotive than an airplane—and two LTV F-8 Crusaders huddle against one wall, while a Polikarpov I-16, a Pekingese-faced, barrel-chested peanut of a fighter, seemingly an illegitimate offspring of the GeeBee racers of the early 1930s, stands by itself on an expanse of white floor. In another building, not open to visitors, original engines, many of them encrusted with years of oil and dust, rest on pallets.

In a rare compromise, Vintage Wings may machine new turbine wheels of

Germany developed the airlaunched Fieseler Fi 103R manned missile at the end of World War II, but never used it.



PERFECT AUTHENTICITY
—ESPECIALLY IN THE

ME 262,
THEN-IMMATURE





modern high-temperature alloy in order for the Me 262 to safely fly with its original Junkers Jumo 004 engines, which were designed when high-temperature metallurgy was still in its infancy. At Aero Trader, which is restoring a North American B-25J Mitchell bomber, shop owner Carl Sholl has had to make similar judgment calls. "The edict [from Allen and Thomas] was: If it's on the blueprint for this serial number airplane, that's the way we want it," says Sholl, but "there were a couple of things we had to compromise on that were safety issues...We can't use the original carburetor, because no one in the world is overhauling it. There's no parts available. So we had to resort to a [post-war B-25] carburetor."

Each restoration takes 20,000 to 40,000 man-hours, and while Thomas

Allen's Curtiss JN-4D "Jenny" (above and right) trained military pilots at March Field in Riverside, California, in 1918 and '19.

won't discuss money, acquiring and restoring each airplane must cost at least a million dollars, and more likely two. At WestPac, one of 14 employees works at a computer terminal, duplicating the designs of decals, stencils, and rubber stamps; two others study microfilmed documentation and track down manufacturers who either produced original parts during the war or are willing and able to set up obsolete production processes to re-create them today. Nuts and bolts, certain types of rivets, tires, electrical wiring-all must be manufactured anew just as they were six decades ago. The ink in the stamp pads—much of the



MAN-HOURS,

AT LEAST A



lettering on the Mustang, for instance, was rubber-stamped—is chemically correct.

Each part, including those that disappear into the unvisited recesses of structure, must have a quality controller's inspection stamp identical to the ones used at the original factory. "There's no such thing as 'They'll never see it,' " says WestPac's soft-spoken president, Bill Klaers. Restorers use parts and equipment that are identical to the ones originally used; even though many versions of an accessory would fit and function in the airplane, only the one with which it was originally produced is acceptable.

Getting the Flying Heritage Collec-

tion work "was a dream come true," says Klaers. "All restorers say that they wish a customer had the money to do a restoration back to original specs—the final 10 percent," he says. "After doing one, I realize that I never knew how difficult that final 10 percent would be...It's changed my idea of restoration...Now I'd never go back."

The collection's Republic P-47 Thunderbolt is under restoration at West-Pac; the FG-1D Corsair is next in line, and the Lockheed P-38J after that. Other treasures, which include a rare CASA 2.111D bomber (a Spanish-built Heinkel He 111H) and a Yakovlev Yak-3U fighter are in storage in Arlington, their restorations not yet scheduled.

WestPac's Larry Klaers (above, left) and Alan Wojciak work on a P-47 engine mount. Dave Gallup (opposite, left) and Bill Barclay make sure that even the decals are accurate.

WestPac had to relearn old techniques, like the spot-welding of heat-treatable aircraft alloys, because although the same effect could be had today by riveting, that's not how it was originally done. The spot-welding in the Mustang—the "doghouse" containing the radiator ducting consisted of three large spot-welded subassemblies—was, says Klaers, "the most cost-ineffective thing on the airplane." But it was worth it. His clientele has ex-





panded, he says, to include "collectors who want to take advantage of this costly educational experience."

JME Aviation is restoring the collection's Fw 190 as well as its Me 262. Fw 190s were the best of the Axis propeller fighters, and are rare today; about two dozen airframes, or portions of them, are known. No flying example of reasonable authenticity exists.

The collection's Fw 190 came from Russia, where it had lain for decades, upright and relatively undamaged, in a remote forest east of Leningrad (St. Petersburg today). What was an airplane doing deep in a forest? The answer, deduced from the damage to the leading edges of the wings, was that it had crashed among poplar saplings only a few feet tall. The forest had grown up around it.

Flash back to July 19, 1943. Two Fw 190s were attacking a Russian supply train bound for Leningrad when the engine of one quit. The pilot, Sergeant Paul Rätz, glided to a safe landing. He left his flying cap on the seat but took the airplane's panel clock with him. Trying to make his way back to German lines, he was captured a few miles away and remained imprisoned in Russia for 16 years before finally returning to Germany. In 1988, a collector found the Focke-Wulf where Rätz had left it, his helmet still resting on the seat. Rätz died in 1989, never having learned that his airplane had been recovered. But his family did—and, it turns out, they still have the clock.

A Vintage Wings technician dismantling the 190's BMW 801 engine found a clod of dirt in an oil line down-

Germany's Fieseler Fi 156 Storch (opposite) was a World War II short-takeoff-and-landing personnel transport. The last flying example of the P-40C Tomahawk (right) fought for the Soviet air force. stream from the oil filter. This had evidently been the reason for the forced landing: Lack of lubrication had caused an internal shaft to overheat and fail, disabling the fuel and oil pumps. But how had the dirt—not engine dirt, but soil, earth—gotten there? Says Jeff Thomas, "BMW's policy on major engine maintenance was to insist that the whole 'power egg'—the engine and all of its plumbing and equipment and mounting hardware—just be taken off and sent back to the factory rather than repaired in the field." As a result, all engine assembly was done in Germany, some of it by slave laborers. The theory is that one of those laborers had packed dirt into the oil line to sabotage the engine, the engine had then been shipped to Russia and installed on the airplane at the front, and within a few minutes after takeoff the defiant act of the distant and anonymous captive had done its work.

The minute historical precision and obsessive fidelity to truth that characterize the Flying Heritage Collection raise a philosophical question. History has not been entirely kind to the 19th century French architectural historian Eugène Viollet-le-Duc, whose painstakingly researched restorations of the great masterpieces of French medieval and Gothic architecture were later criticized for effacing the boundary between what was original and what was new, albeit re-created with

original methods and appropriate materials. In that case, antiquity in and of itself—the knowledge that the original stones, however corroded now by time, had witnessed the coronations and the deaths of kings and so possessed a higher kind of truth—was seen as a thing distinct from mere antique forms, however authentically expressed. The same sort of misgiving might beset the visitor who stands before *Upupa epops*, unable to know which of the pieces of metal before him were present when Bud Tordoff shot down that Me 262, and which were not.

But most who make the pilgrimage to this remarkable collection will be untroubled by that scruple. Bill Klaers, who with his business partner Alan Wojciak had owned a Mustang and had seen and flown countless others, says, until he saw the finished *Upupa epops*, "I never knew what a Mustang looked like!" John Dibbs, whose photography accompanies this article and who wears his love of old airplanes on his sleeve, speaks of a "change in temperature" that he feels when he faces the old Mustang—the chill of knowing that this is the real thing, this is exactly how it was. When, ten years from now, the Flying Heritage Collection's airplanes have all been restored, and they are on the ramp with their engines running on a flying day, that chill will be felt by many: the momentary sense of the past recaptured, of Then made Now.



SIGHTINGS



iguring out how to refuel airplanes in flight has probably spawned as many bad ideas as good ones. In the 1920s, wingwalkers tried handdelivering cans of fuel from one airplane to another, while Navy pilots experimented with grappling hooks to snag containers from floats in a river.

By 1956, when a Convair R3Y Tradewind amphibious transport gassed up a then-record four Navy jets (F9F-8 Cougars) at the same time (right), aerial refueling had become a pretty routine procedure. But 30 years later, Dick Rutan and Jeana Yeager were able to skirt the whole problem by circling the globe on one fill-'er-up in the *Voyager*.

Then there were Clyde Schlieper and Wes Carroll, two fliers out of Long Beach, California, who set an endurance record in 1939 by keeping a Piper Cub airborne for 660 hours (shown above, over California's Mojave Desert). The airplane was refueled three gallons at a time from a car speeding along below; the Cub's floats served as fuel tanks.

According to a contemporary newspaper article, "Wives of the two pilots have acted as cooks and quartermasters, sending food aloft at the end of the rope." Some people can't stop for anything.

(These pictures are from a collection of photographs for sale; they can be seen at *www.planepix.com*.)





Stellar Illustration

Astronomy: A Visual Guide

by Mark Garlick. Firefly Books, 2004. 303 pp., \$29.95.

ark Garlick's Astronomy: A Visual Guide is one of those books that looks attractive and inviting on a coffee table; one can just as easily browse it as read it cover to cover.

The author is not only a Ph.D. astrophysicist but an accomplished space artist as well. His depictions of various astrophysical processes complement the superb collection of images that have been captured by today's ground- and space-based observatories. These images are now obtained by peering through different "windows" in the entire electromagnetic

spectrum—from low-energy radio emissions to the most energetic gamma-rays. Many of the images have been made over the past decade by the Hubble Space Telescope, and a generous collection of "Hubble's Greatest Hits" are sprinkled among the pages. Each of these is a work of art, and they can evoke in the viewer an almost intuitive understanding of the

processes they depict.

After a thorough introduction to the various types of celestial objects that inhabit the night sky, roughly one-third of the book is devoted to teaching readers how to find some of the

POYAL SWEDSH ACADEMY OF SCHAUES

Looking like the flesh of a rotten peach, this image of sunspots—cooler, darker patches found on the sun's photosphere—is typical of Astronomy's unique art direction.

better-known examples. A primer on the motions of the sun, moon, planets, stars, and constellations (and tools for observing them) provides the basic information one needs to begin amateur observations. Monthly star charts for

both the northern and southern hemisphere are faced with pages that highlight three "showpiece" objects from each chart, though this can be a bit misleading; when viewed through a humble amateur instrument, few celestial sights will look like images from the Hubble Space Telescope.

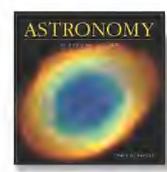
The book concludes with a chapter devoted to several of the unfolding mysteries, such as dark matter, gammaray bursters, and life in the universe, that still challenge our cognitive powers and keep the universe shrouded in mystery. An up-to-date appendix

contains dozens of lists of the most recent facts and findings, including the recent discovery of swarms of moonlets circling the giant outer planets, planetary probes of the past and those planned for the future, and eclipses through the year 2016.

Astronomy is not without flaws. A photo of Halley's Comet snapped in 1910 is labeled as an image made by the European Giotto spacecraft in 1986. Some pseudo-science has unfortunately crept in as well. The purported "alignment" of the Giza Pyramids with the constellation Orion is touted in both text and illustration, and the construction of Stonehenge is attributed to the Druids.

However, these do little to detract from the overall scope and beauty of the book. I look forward to having my friends leaf through it in my living room some evening before we adjourn to the telescope to see some of these wonders for ourselves.

—Geoff Chester is an avid amateur astronomer and the public affairs officer for the United States Naval Observatory in Washington, D.C.



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Wings of Gold

by Gerald Astor. Presidio Press, 2004. 453 pp., \$26.95.

nited States naval aviation in World
War II got a dubious start with
F4F Wildcats from the carrier
Enterprise falling to friendly fire at Pearl
Harbor in 1941. During Japan's surrender

The U.S. Naval Air Campaign

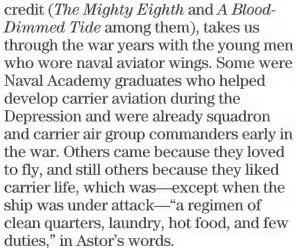
WINGS

OF

GOLD

ceremony in Tokyo Bay in 1945, naval aviators participated in the largest aerial formation ever assembled: 2,000 aircraft swarming overhead.

Gerald Astor, a military historian with a half-dozen solid titles to his



Naval aviators have always been a distinctive breed, and when *Wings of Gold* allows them to tell their tales in their words, the reader has the feeling of being there, watching Ed "Whitey" Feightner fighting Japanese Zeros in a Wildcat near Guadalcanal, or Tom Moorer coaxing his PBY Catalina flying boat into "the biggest thunder cloud we could find" to evade Japanese fighters.

To Astor's credit, *Wings* is not limited to the Pacific island-hopping campaigns or to operations from carrier decks. Some of the most challenging wartime missions were flown by lumbering Catalinas and by four-engine PB4Y-1 Liberator bombers. This history gives equal credit to naval aviators who flew in North Africa or on long patrols over a hostile north Atlantic.

Astor's bibliography makes it clear that, while he conducted about 15 interviews, most of the 100 or so first-person accounts are drawn from oral histories assembled by the Naval Institute in Annapolis, Maryland. This volume is a superb attempt to present the best passages from those histories, but I found myself wishing Astor had personally talked to a wider selection of veterans.

—Robert F. Dorr writes a weekly history article for Navy Times. His latest book is Wingless Warriors.

DESTINATION: MOON

New Moon Rising

by Frank Sietzen, Jr. and Keith Cowing. Apogee Books, 2004. 280 pp., \$33.95.

Moonrush

by Dennis Wingo. Apogee Books, 2004. 260 pp., \$24.95.

n January 2004 President Bush announced a new space exploration strategy (see Commentary, p. 56) that, among other things, calls for sending Americans back to the moon by no later than 2020. The plan was instantly controversial, and as of September it was caught in a bruising Congressional budget fight. Two new offerings from Apogee Books deal with different aspects of returning humans to the moon.

New Moon Rising, by Frank Sietzen and Keith Cowing, is billed as an insider account of

how the new exploration plan was drafted and how it is likely to be implemented. With subheadings like "Hooray for the Deputies," it is primarily a book for people interested in the mechanics of policy formation,



rather than the technology that might return Americans to the moon.

It is clear that much of the information came from a couple of sources inside NASA, primarily NASA Administrator Sean O'Keefe and his best friend, the agency's now-former General Counsel, Paul Pastorek. The book reflects their points of view and perspectives, rather than presenting an objective account. A number of people mentioned were clearly not consulted for their own versions of events and are portrayed as grandstanding, arrogant, incompetent, or worse.

Whereas O'Keefe is described in glowing terms, his predecessor, the controversial and abrasive Dan Goldin, is portrayed entirely negatively, with little mention of his achievements—like completely reforming the robotic spaceflight program. The criticism of Goldin is trivial or irrelevant: There are long descriptions of his going-away parties, for example, and his post-NASA career. The writers also point out that when Goldin left NASA, the International Space Station was a whopping \$4 billion over budget, but they never explain how that happened, or how NASA would ensure that runaway costs would not occur with the new space plan.

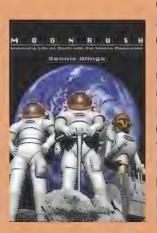
The book was finished in late June and printed by mid-July. It is therefore topical, but exhibits many of the problems one would expect from such a quick turnaround time, including numerous typographical and

grammatical errors and haphazard editing. Like most Apogee books, it features text that nearly runs off the page, making for difficult reading.

Despite the flaws and biases, *New Moon Rising* does provide the first inside account of how the new space exploration strategy was developed. It is likely to remain the only detailed report on this subject for many years to come and cannot be ignored.

Dennis Wingo's *Moonrush* is about the moon's potential to provide a solution to the world's future energy needs. Unlike previous space advocates, who have often demonstrated a poor grasp of social and economic forces, Wingo not only understands these forces, but makes a surprisingly comprehensive and logical argument for space development.

Wingo analyzed various projections of world oil reserves and concluded that even with the most optimistic estimates (made by oil producers themselves), the world will have to find substantial alternatives to oil within the next five to six decades. Wingo proposes a hydrogen economy, based primarily on fusion and fuel cells. Solar power and fission



can eventually be supplemented by commercial fusion reactors for generating electricity. Gasoline-powered engines can be replaced with fuel cells, which require rare materials like platinum that are probably abundant on the moon. It thus

makes sense to go there and mine them

Wingo's proposed solution has some major problems. Fusion advocates have been promising success for decades now, so their claim that commercially viable fusion can be achieved in only 15 years has limited credibility. The cost of launching vehicles to the moon is extremely high, and even if it can be reduced to a tenth of the current cost, it is difficult to see how mining lunar materials will be profitable. Furthermore, resource constraints are inevitably solved by technological substitution. If there is not enough platinum to supply the fuel cells that will substitute for gasoline, engineers will find an alternative to fuel cells, making lunar mining unnecessary.

But a lot of Wingo's suggestions for working toward his goals are sensible. The book includes a detailed analysis of the weaknesses and biases of past lunar exploration plans. *Moonrush* is a well-researched, thought-provoking book, even if it does not have all the answers to the impending demise of the petroleum economy.

—Dwayne A. Day is a science and space writer based in northern Virginia.



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CALENDAR

September 30—October 3

Reunion: 368th Fighter Group, World War II, 9th Air Force. Essex Inn, Chicago, IL. For information, call Randolph Goulding at (678) 333-0241.

October 1—3

Bellanca-Champion Club East Coast Fly-In. Pottstown Municipal Airport, PA, (518) 731-6800 or visit the Web site at www.bellanca-championclub.com.

October 2

Naval Air Warfare Seminar: Featuring carrier-based aircraft. The Planes of Fame Museum, Chino, CA, (909) 597-3722, www.planesoffame.org.

SR-71 Forum. Meet former pilots who flew the Lockheed SR-71 reconnaissance aircraft and take a tour of an SR-71. Virginia Aviation Museum, Richmond International Airport, VA, (804) 236-3622.

October 2 & 3

Fina-CAF AIRSHO. Commemorative Air Force Headquarters, Midland International Airport, Midland, TX, (432) 563-1000, www.airsho.org.

October 10

Foreign Auto Festival & Antique Aeroplane Show. Owls Head Transportation Museum, Owls Head, ME, (207) 594-4418, www.owlshead.org.

October 15 & 16

Pompano Beach Air Fair. Pompano Air Park, FL, (954) 803-5722, www.airfair.org.

November 3 & 4

Embry-Riddle Aeronautical University Industry/Career Expo. More than 100 aviation/aerospace employers will be on hand to talk with job seekers. ICI Center, Embry-Riddle Aeronautical University, Daytona Beach, FL, (386) 226-7018.

November 6

Flight Test Operations Seminar. Featuring a Northrop N9MB Flying Wing. The Planes of Fame Museum, Chino, CA, (909) 597-3722, www.planesoffame.org.

November 6 & 7

Celebrate Freedom Festival. Woodward Field Airport, Camden, SC, (803) 772-2945.

Organizations wishing to have events published in Calendar should fax press releases two months in advance to (202) 275-1886 or mail them to Calendar, Air & Space/Smithsonian, MRC 951, P.O. Box 37012, Washington, DC 20013-7012.

CREDITS

Jungle Graveyard. Longtime contributor Carl Posey is researching a novel set in Panama in the late 1930s.

The Unwelcoming Committee. As a farm boy from California who joined the Air Force, Walter B. Rowe considers himself fortunate to have been stationed at Edwards Air Force Base. He still eyes every helicopter that passes overhead.

Prop Art. Linda Shiner is the executive editor at *Air & Space/Smithsonian*.

Howard Hughes' Top Ten. Preston Lerner chronicled the construction of Jim Wright's extraordinary replica of the Hughes Racer in the Apr./May 2003 issue.

Further reading: *Howard Hughes—Aviator*, George J. Marrett, Naval Institute Press, 2004.

Hughes Air Force. Illustrator Paul DiMare is a frequent contributor.

Dancing in the Dark. John Croft is a freelance aviation writer, aerospace engineer, and FAA-certified flight instructor based in Upper Marlboro, Maryland.

The People and Planes of Flabob. Marshall Lumsden last wrote "The People and Planes of Santa Paula" (Feb./Mar. 2004).

Photographer Chad Slattery is based in Los Angeles. He recommends the pancake breakfast at Flabob's Chapter 33 fly-ins.

Contact. Tony Reichhardt is a consulting editor at *Air & Space*.

Crown Jewels. Peter Garrison is a contributing editor at *Flying* magazine.

John M. Dibbs started out working in fashion photography and graphic design in London, but he is now a full-time aviation photographer. He has been in more than 800 air-to-air sorties and has flown in 120 types of aircraft.



"It looks like they experimented with flight."

ON THE WEB SITE

www.airspacemag.com



Posters: rousing, if not refined.

Visit a virtual exhibit of military aviation posters from Bruce Whitman's collection. The exhibit spans both world wars and includes recruiting posters and those created to increase the vigilance and productivity of the workers who built warplanes (see "Prop Art," p. 20).

Also, link to our picks of the best Web sites for learning about Mars exploration and other planetary affairs.

FORECAST

In the Wings...

Global Hawk Goes to War

During the war in Iraq, the U.S. Air Force destroyed 300 Iraqi tanks, based on images relayed by the Ione Global Hawk deployed there. Its operators never left their U.S. base. Here's how they did it.

BONUS POSTER

What's Inside the Global Hawk

When the Going Gets Tough in Space

On March 18, 1965, cosmonaut Alexei Leonov became the first man to walk in space. And he almost became the first to die there. In an excerpt from his new book, Leonov tells his harrowing story.

For the Beauty of It

Modern composite sailplanes perform far better, so why do pilots keep flying their vintage wood-and-fabric craft?



Northrop Grumman's unmanned RQ-4A Global Hawk can fly at 65,000 feet for 36 hours.

Can This Airplane Be Saved?

In August 2001, the Federal Aviation Administration issued a directive that would have, in effect, grounded the U.S. fleet of Beech T-34 Mentors. That's when the T-34 operators decided to solve the problem themselves.

The Last One Out at Long Beach

Where Douglas DC-8s were once built, workers now assemble Boeing 717s. Will it be the last airliner to roll off this line?



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Going for the Green and Gold

've always been obsessed with air racing," says former astronaut and frequent Reno air race competitor Robert "Hoot" Gibson. "I wanted to own a Formula One plane since I was 18, and I was going to paint it green and gold."

Last spring, Gibson set a world speed record on a closed course for aircraft weighing between 300 and 500 kilograms (661 and 1,102 pounds), averaging 238.1 mph in a green and gold Cassutt racer he's owned for two decades now. Though he has set records earlier in his career as both an astronaut and a pilot, he says this is the one he's proudest of.

It took a year to get from conception to record. In 1991, when he set an altitude record in the Cassutt, his speed was about 225 mph. To set a record, he would have to average 229 mph on a closed course—with a 180-degree turn in the middle of the flight. "The first thing I had to do was clean the plane up and make it faster," he says. Gibson replaced the canopy to cut down on drag and installed a rebuilt engine that gave him more power and another 50 mph.

Gibson chose his hometown airport in Murfreesboro, Tennessee, as the starting ever gave out on me." Because he would need to be at full throttle for 18 minutes. he chose to coddle the engine, and so made no high-speed runs before the attempt to see what his top speed was.

On April 28, "I crossed the starting line, and I knew something was wrong," he says. "My ground speed was very low, but I knew the plane was performing fine. I figured out I must have been flying into a headwind." He dropped down to the lowest altitude allowed for the outbound leg, trying to avoid much of the wind.

The next pitfall was the turn for home. Gibson needed to keep his turning time short to keep his average speed high. To have a chance at the record, he had to complete the turn in under 30 seconds. Pulling 4 to 5 Gs, he made the turn in just 11 seconds. Flying at 1,500 feet on the way back to Murfreesboro, the Cassutt rode the tailwind to a world record, bettering the old mark by four percent.

Gibson flew fighters in the Navy, was the pilot on his first shuttle mission and commander on his next four, and now flies for Southwest Airlines. "Flying [the Cassutt] is an absolute joy," he says. "I've been making up for lost time ever since I bought it. I tell people it's kind of like



L O G B O O K

Awards

The National Aeronautic Association has awarded Admiral Wesley McDonald, U.S. Navy (ret.), this year's Cliff Henderson Award, which is presented annually to an individual whose vision, leadership, or skill has made a significant contribution to the promotion and advancement of aviation or spaceflight.

McDonald graduated from the U.S. Naval Academy in 1946 and began his career as a naval aviator in 1950, serving in several carrier fighter and attack squadrons. In 1964, he was a flight leader in the Vietnam War, leading the first retaliatory strike in North Vietnam following the Gulf of Tonkin incident. By the end of that conflict he had been promoted to Carrier Battle Group Commander in the Western Pacific. He later served as deputy chief of Naval Personnel in Washington, D.C., and retired in 1985 as the North Atlantic Treaty Organization's Supreme Allied Commander Atlantic, and Commander in Chief, U.S. Atlantic Fleet. He oversaw the U.S. intervention in Grenada in October 1983 while leading both the U.S. and NATO forces in the region.

Since his retirement, McDonald has been prominent in the aviation community, holding leadership positions with the National Aviation Club and as the chairman of the NAA's board of directors. McDonald is also on the boards of the U.S. Navy Memorial Foundation, the U.S. Naval Aviation Museum, and the Armed Services YMCA. McDonald will receive the Henderson Trophy at NAA's annual Fall Awards Banquet, on November 8 in Arlington, Virginia.

The National Aeronautic Association is the National Aero Club of the United States. The NAA, America's oldest national aviation association, traces its roots to 1905, when the Aero Club of America was founded.



THE AIRCRAFT OF HOWARD HUGHES



The Hughes H-1 Racer is in the Golden Age of Flight gallery of the National Air and Space Museum.

